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THE OTTAWA FIELD-NATURALISTS' CLUB

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The CANADIAN FIELD-NATURALIST

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THE OTTAWA FIELD-NATURALISTS' CLUB

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CONSERVATION AND THE POPULATION PROBLEM

We are all concerned with the problem of conserving natural areas. We are willing to devote our time and energies to this cause, in part, because we feel that it is important to maintain a world that has many different kinds of places for ourselves and our children to enjoy. Our efforts to accomplish this have been moderately successful, and are increasing both in scope and intensity. Yet they are doomed to ultimate failure unless something is done about the most critical problem facing us at the present time, the human population problem.

Ten thousand years ago, soon after the close of the last glacial cycle, there were fewer people in the entire world than there are in metropolitan Tokyo at the present day. From the fewer than ten million people alive at that time have descended the 3.5 billion people who inhabit the world today. The world population has been doubling at an ever increasing rate, and it is estimated that there will be nearly 7 billion people living on earth at the close of the present century. The world population at the present time is so enormous that if all the people on earth stood in a single line, they would reach to the moon and back, twice.

Some eight thousand years ago, the human population of the earth began to grow sharply. This occurred because of the discovery of agriculture. By growing crops in dense stands, man was able to produce enough food to allow the formation of towns and cities. In these densely populated centers, he attained high standards of civilization. Agriculture originated in the Near East, and by 3000 B.C. it had spread to all the plains of Europe south of the Scandanavian mountains. In the Far East, agriculture revolved around the cultivation of rice, and in Middle America, it was based on corn. Advanced civilizations developed independently in each of these centers.

The most stable communities on earth are those which involve large numbers of species of plants and animals in complex associations. In agriculture, the effort is to maintain one or at most a few species in a pure stand. The productivity may be high, but the community is basically unstable. Essential elements are "mined" from the soil when the crops are removed, and the soil deteriorates rapidly under the full brunt of the weather. Insecticides must be used to prevent insects and other pests from consuming the entire crop rapidly and efficiently. When these insecticides and fertilizers enter into the world ecosystem, they have clearly undesirable side effects, yet they must be used to insure the production of crops in sufficient quantities to feed the present population of the earth.

According to current estimates, at least 2 billion of the current world population of 3.5 billion is undernourished, and millions starve to death each year. If the present level of application of pesticides and fertilizers were

Mailing date of this number: 30th April, 1969.

decreased, an even higher proportion of the world's population would be undernourished, and more would starve. If the application of these chemicals is continued at present rates, they will accumulate and eventually destroy all of the world's ecosystems. Huge industries stand behind the manufacture and use of insecticides and fertilizers, and it is difficult to imagine a government so enlightened that it would sharply restrict their usage in the face of world starvation. The decision to do so is a wholly unpalatable one at the present time, but it is a decision that we must eventually make if we are to survive.

In the tropics, the problems of agriculture are particularly great. The clayey red laterite soils characteristic of tropical regions cannot be cultivated for long once the forest is cleared. Under the constant pounding of tropical rainstorms, they form cement-like layers that cannot be broken by any known plow. When human populations in the tropics were at low levels, they subsisted by successively cultivating cleared patches of forest, then abandoning them while the forest regenerated. At high levels of population, this sort of cycle is not possible; all of the available land must be brought under cultivation to feed the people. But the intensive cultivation of tropical soils rapidly renders them useless. Many ancient civilizations have vanished in the tropics, and the basic reason may be the inability of tropical soils to support a high human population indefinitely. Today, it is the tropical countries which have the most rapidly growing populations, and what is tragedy for their inhabitants may ultimately be tragedy for us all.

For there are absolute limits to the population of the earth. J. H. Fremlin, a British physicist, has calculated that the ultimate limit would be set by the ability of the earth to radiate heat into space and so to maintain a temperature at which living things can survive[1]. Man and his activities produce heat in many ways. At high enough population levels, they would produce enough heat to exceed the limit of what could be radiated. Beyond this point, the temperature of the earth would climb sharply, and all living things would perish. When would this desperate situation be attained at present rates of growth?

At the heat limit, one can calculate, there would be some sixty million billion people, who would have to be housed in a tall apartment structure of hundreds of stories covering the entire land and sea. The people would be at a density of about 100 persons for each square yard of the earth's surface. Such a warren could theoretically be constructed. The quality of human life in it would obviously be so low, we might wonder if it could properly be called human. And this would clearly be the absolute limit: *No* more people could be added regardless of the scientific advances that might be made. There would be an absolute necessity for practicing stringent population control to prevent the human population from climbing still further and perishing.

Well, you must say, this nightmarish predicament would not possibly arise for many thousands of years. In fact, at present rates of growth, it would be attained in about 900 years: about as far in the future as the Norman Conquest was in the past.

Could we not then colonize the planets, and ship off the excess people to far corners of the universe? In perhaps 250 years we would populate all the planets of the solar system to the same density as the earth. And even for this very limited solution the economics are frightening. For example, Professor Garrett Hardin, of the University of California, Santa Barbara, has calculated that, using the most favorable assumptions, the citizens of the United States and Canada could, by cutting their standard of living to a fifth of its present level, accumulate enough capital in a year to export *one day's* increase in the population of the world!

Clearly, then there are real limits to population expansion regardless of what science can accomplish. Increased food production, while it is highly desirable, will not allow unlimited growth. At some point stringent control of population growth will have to be practiced. Any statement which discourages population control at the present time is irresponsible and immoral, and has the effect of condemning millions of people to an untimely and horrible death. The quality of human life deteriorates with population growth, and we have a choice: at what point will we accept the inevitable and halt the deterioration?

As Professor Paul Ehrlich of Stanford University has stressed[2], we are all inhabitants of a space ship of limited carrying capacity, and we must survive or perish as citizens of the earth. National limits have no meaning for the survival of the world, and the fate of the people living in India or Nigeria is inseparably linked with our own. In view of this, isolationism and limited solutions should have no place in our thinking. As a human race, we are in the present day facing our greatest challenge.

PETER H. RAVEN

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SCIENTIFIC AND CULTURAL STUDIES OF THE MER BLEUE

W. K. W. Baldwin and Theodore Mosquin

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With this issue, the Canadian Field-Naturalist begins the publication of a series of papers on the Mer Bleue Peatland. The aim of this series is to provide a continuing publication outlet for studies dealing mainly with scientific aspects of the natural history of the area. However, the choice of title for the series is based on the fact that the Mer Bleue is not only a scientific and natural history facility but also a natural cultural asset to all people of the Ottawa region. Hence, it is probable that special studies dealing with recreational and educational aspects of the Mer Bleue will be included in this series even though such contributions, of necessity, may be of a controversial nature.

The Mer Bleue is a large (6,300 acres), relatively natural area of bog and fen which reaches into the Greenbelt of the National Capital area about 7 miles east of the Parliament Buildings. It occupies an abandoned channel scoured out in clay plains some 8,000 years ago by the ancient Ottawa River following the withdrawal of the marine Champlain Sea. It consists of three more or less distinct basins. The center of the Mer Bleue is a raised bog or "hochmoor", slightly domed where *Sphagnum* peat has built up most deeply, and sloping off to the marginal "lag" or natural drainage moat. The depth of peat in the center is from 10 to 20 feet and the peat includes large quantities of stumps and logs. Elevated islands of alluvium deposited in the old stream channel penetrate the Mer Bleue providing some outlooks and access to the central part. At the east and where the wetland meets farmland, a variety of habitats suitable for the breeding of game birds exists, and all around the edge of the bog there are sedge and cattail swamps interspersed with ponds that are attractive to waterfowl and other wildlife. The Mer Bleue has extensive black spruce and tamarack stands with small birches, open leatherleaf heaths and cottongrass communities. It has survived various disturbances: the encroachment of farming around the edges; attempts to exploit peat for fuel and horticulture; ditch digging as a make-work for the unemployed in the depression of the 1930's; use as a range for testing aerial bombing during the Second World War and the testing of track vehicles in later years.

The Mer Bleue has long been valued for its rare and otherwise interesting plants and animals and for the fact that it is a unique feature in the landscape of the Ottawa region. It is the first place in the New World where a modern analysis of fossil pollen was made and is also the area from which many type specimens were collected. It is very accessible from the many research centres of the Ottawa region. The Mer Bleue is outstanding among the many peatlands, both fens and bogs, in the Upper St. Lawrence Section of the Great Lakes-St. Lawrence Forest Region because it is the largest of its kind remaining

in an approximation to a natural state. The western two thirds is part of the Greenbelt and owned by the National Capital Commission; the eastern third is privately owned.

In 1963 the Ottawa Field-Naturalist's Club was alarmed by rumours of possible future dumping of garbage on the Mer Bleue. Enquiries and meetings were held that disclosed a wide concern of naturalists, scientists and other people in this fascinating area. Club records noted excursions there dating back to the 1880's and interest is now increasing. Contacts with scientists at the Geological Survey of Canada, the National Museum, the Plant and Entomology Research Institutes in the Department of Agriculture, the Canadian Wildlife Service, the National Research Council, the Department of Forestry and the universities at Carleton and Ottawa, revealed their lively interests in continuing research in this classic locality and unique environment. In 1963 the Canada Department of Forestry provided a valuable large-scale vegetation map of the Mer Bleue for the use of research scientists and naturalists. The club took up the matter of the future of the Mer Bleue with the Chairman of the National Capital Commission which is the principal owner of the land. A committee was appointed to evaluate the area and its environs and to advise upon its future management. Dr. J. S. Rowe, chairman of the *ad hoc* committee, presented a full report to the National Capital Commission on July 21, 1965 (Rowe, 1965a). At the same time Rowe also prepared a special report for the Canada Department of Forestry (Rowe, 1965b). It was during this period that the idea developed for a special issue or series in the CANADIAN FIELD-NATURALIST to be devoted to all aspects of the Mer Bleue.

In the consultations with various scientists it became apparent that we are just at the beginning of our understanding of peatlands in Canada and that there was a real need for a focus and stimulus to research into them and their component bogs and fens. Some forty authors indicated their willingness to contribute.

The initiative of the Ottawa Field-Naturalists' Club has stimulated the National Capital Commission to assemble most, but not yet all, of the Mer Bleue into public ownership under Commission management. It has been recommended that the commission acquire the whole of the ecosystem including the critical throughholds to its drainage.

There are indeed several good precedents for our attempt to bring diverse contributions together in print. The Cambridge Naturalists in England have published a long set of papers (Gardiner, 1923 to 1932) dealing with the many aspects of the famous Wicken Fen, which is now successfully conserved and managed by the National Trust. Likewise, the many publications by Dr. W. W. Judd, Department of Zoology, University of Western Ontario, have had an important bearing on the eventual preservation and conservation of the Byron Bog located near the heart of London, Ontario (Judd, 1967). This is the first time that the Ottawa Field-Naturalists' Club has embarked on such a publication enterprise. Like the Wicken Fen and the Byron Bog, we hope that the Mer Bleue Peatland will be preserved as "a reservoir of wild nature from which the man of thought may draw inspiration in his task of tracing

the past and foretelling the future of life." Whether it will prove possible to develop a program that will conserve, manage and develop the entire Mer Bleue, only the future will tell. Certainly if the Mer Bleue is to survive indefinitely, the essential hydrologic regime of the entire area will have to be managed as a unit, since the health of each part depends on the whole.

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POLLEN RECORD AT THE MER BLEUE[1]

M. Camfield
Geological Survey of Canada, Ottawa, Ontario

Introduction

The pollen grains of flowering plants are carried from the anthers to receptive stigmas by the wind or by insects. They are small, from 10 to 100 microns, and very light and can therefore easily be transported by either means. Not unnaturally most smaller plants are pollinated by insects and most tall trees by the breezes blowing through their branches.

The chances of a particular pollen grain landing on an appropriate stigma are slight and it is only because pollen is produced in such vast quantities (some trees may produce pollen in regular clouds) that this method is so successful. Thus only a fraction of the millions of pollen grains released actually function in fertilisation. The wind carries the rest, sometimes over many miles, until they settle down to earth or, for our purposes, into bodies of water or bogs.

Each pollen grain has a skin or external skeleton known as exine, which in an oxygen poor environment, such as a sphagnum bog or mud at the bottom of a lake, may be preserved with little change almost indefinitely, and may thus be available for study thousands of years after the plant that bore it died and rotted away. Moreover exine has properties, such as shape, thickness, ornaments and pores, that under the microscope generally permit identification of the genus and sometimes of the species of the parent plant.

Each year clouds of pollen fell on the Mer Bleue and were buried in the growing bog, so that year by year a record was preserved of the plants, in particular of the trees, that grew at that time in the district. As the flora of a district is to a considerable extent controlled by the climate, changes in climate too may be deduced from the pollen record.

The special value of the tree record was stressed above because tree pollen (arboreal pollen), will obviously leave a more uniform record from one part of a bog to another, or from one bog to another. Non-arboreal pollen is much more local, for pollen from a clump of a certain plant will naturally be more plentiful near the clump than farther out in the bog where perhaps the plant does not grow at all. However, not all wind born pollen is from trees and some plants from open lands and pastures, particularly weeds and grasses, may leave clear records and indicate the proportion of forest cover to open ground.

It will be recognized that major climatic changes will occur at about the same time over considerable tracts and a record of a particular change may be used to relate the history of one bog with that of another, and eventually the climatic history of the whole region may be pieced together. The times of this record will, however, only be relative and for an absolute dating the

[1]Contribution No. 1 to the series "Scientific and Cultural Studies of the Mer Bleue" (see Canadian Field-Naturalist 83(1):4-6. 1969.

method using the isotope Carbon 14 must be used. One such determination has been made for the Mer Bleue and indicates that the basal organic sediments in the abandoned Ottawa River channel were deposited between 7,400 and 7,900 years ago[2]. In the Mer Bleue, therefore, we have a record of conditions during the last 7,500 years or so, or from before 5600 B.C., the time of the Middle Stone Age in Europe and of the earliest painted pottery in the Middle East.

It is gratifying to find such a long unbroken record of the floral history of the region, but it must be remembered, in interpreting it, that this record may be distorted in at least two important ways. Not all pollen grains preserve equally well; the pollen of larch (*Larix*) for instance is preserved infrequently and that of poplar (*Populus*) and white cedar (*Thuja*) hardly ever. The absence of their pollen grains therefore does not mean that the trees themselves were absent. Then again the pines, for example, produce so much windborn pollen, which preserve extremely well, that they are over-represented in the record.

Besides pollen grains, the spores of mosses, club mosses, scouring rushes, ferns and fungi are often preserved, as well as rhizopods and diatom frustules. None of these is as informative for our purpose as the pollen, but they do offer some information on local conditions during certain stages in the development of the Mer Bleue.

Auer (1930) published a tree pollen diagram of the Mer Bleue, using eleven samples. The diagram given here (Figure 2) is more detailed but agrees with Auer's in general trends.

PROCEDURE

The first step in the study of the pollen record of Mer Bleue was to secure a continuous section from top to bottom of the bog in the deepest place. The exact location of the bore hole is shown in Figure 1. The continuous core section was obtained by means of a boring device. This core was taken by Dr. J. Terasmae and R. J. Mott using a Hiller peat borer. Details of sampling techniques may be found in Mott (1966) and samples studied were taken at 20 cm intervals or less. From the samples the pollen grains and spores were extracted[3] and mounted on slides for study under the microscope. Grains from each sample were identified and counted systematically, a total count of 200 or more of tree pollen being considered sufficient to represent properly the entire sample. The grains were considered in three categories, arboreal pollen, non-arboreal pollen, and spores. The number of grains of each item was then expressed as a percentage of the total number of arboreal pollen grains. This base is used as the arboreal pollen is regarded as of special significance because of its relative abundance and uniform distribution.

One of the principal methods of depicting the results of a pollen analysis is by means of a pollen diagram (see Figure 2). In the left hand vertical column is recorded the nature of the various layers of material in the core, the youngest being at the top. In each successive column is plotted the

[2]C-14 date GSC—681—7,650±210 years. Lowdon and Blake (1968).
[3]The pollen was extracted by the use of Erdtman's acetolysis method. Full details of this and other procedures may be found in Erdtman (1943), Terasmae (1958) and Faegri and Iverson (1954).

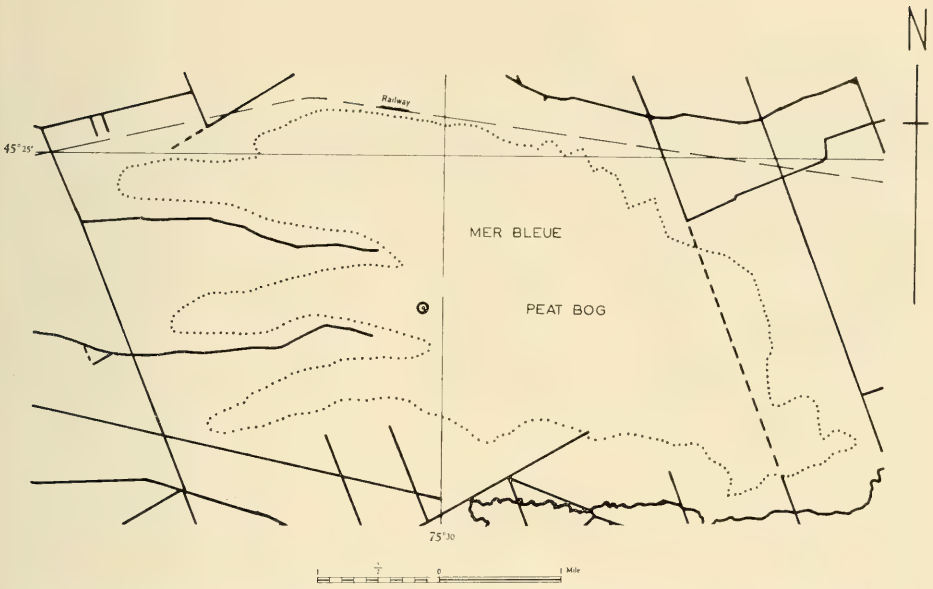


FIGURE 1. Index map of the Mer Bleue, circle marking position of the bore hole.

percentage, as obtained above, of the genus or species listed at the head of the column. For each sample this is plotted horizontally as a histogram, the figure at the bottom of each column showing percentage expressed by the full width of the column. The end of each bar is then joined to complete the diagram. It should be noted that a different scale is used for pollen grains that are plentiful than for those that are scarce.

In some slides a certain form may have been recognized but not have been noted when making the count. Its presence is then indicated by a cross on the diagram. This symbol is also used for some spores or other forms whose presence is of interest but whose abundance is of no general significance.

INTERPRETATION

With this pollen diagram it is now possible to interpret the botanical history of the Mer Bleue itself. Naturally any single section, represented by a single diagram, will show many minor deviations that have only local significance, and some indeed may be accidents of accumulation or sampling. However, if the diagram for Mer Bleue be compared with other pollen diagrams of the Ottawa region (Auer, 1930; Potzger and Courtemanche, 1957; Terasmae, 1960; Mott and Camfield, in preparation), these local variations can be eliminated and a general picture deduced.

In any diagram it can be seen that in parts of the stratigraphic section, representing periods of time, the pollen of certain trees is more plentiful or less plentiful than in other parts. This must clearly indicate some change of conditions, and if the same sequence of changes can be recognized in

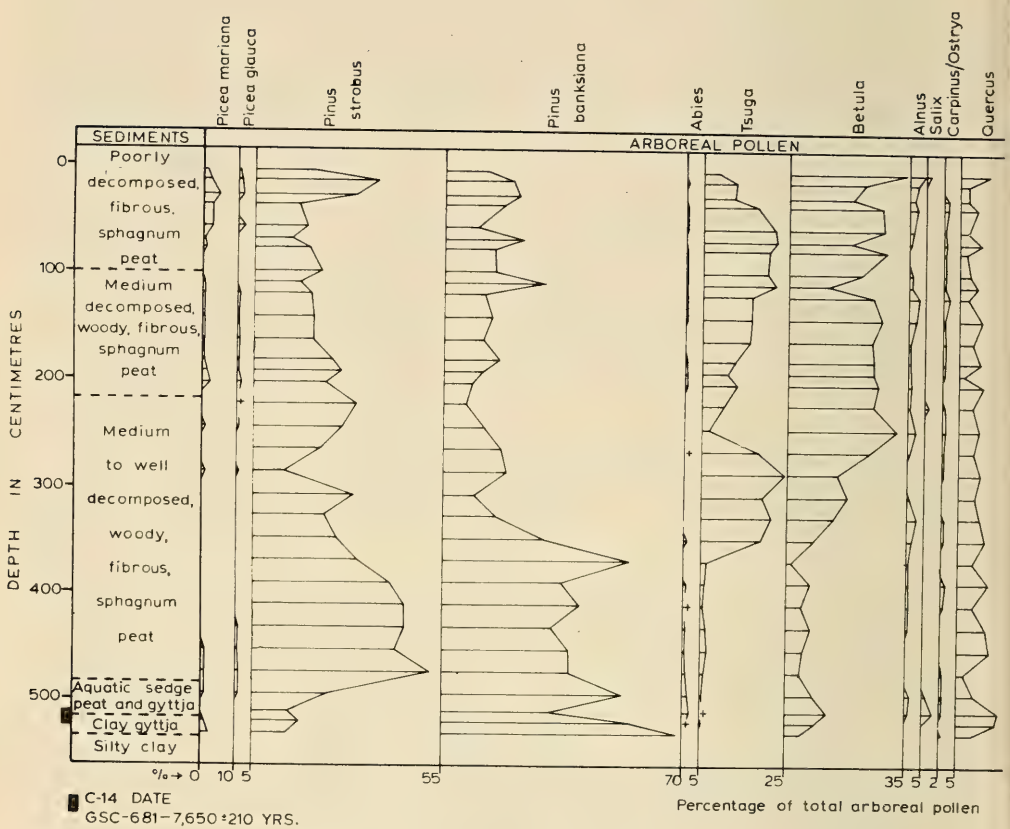
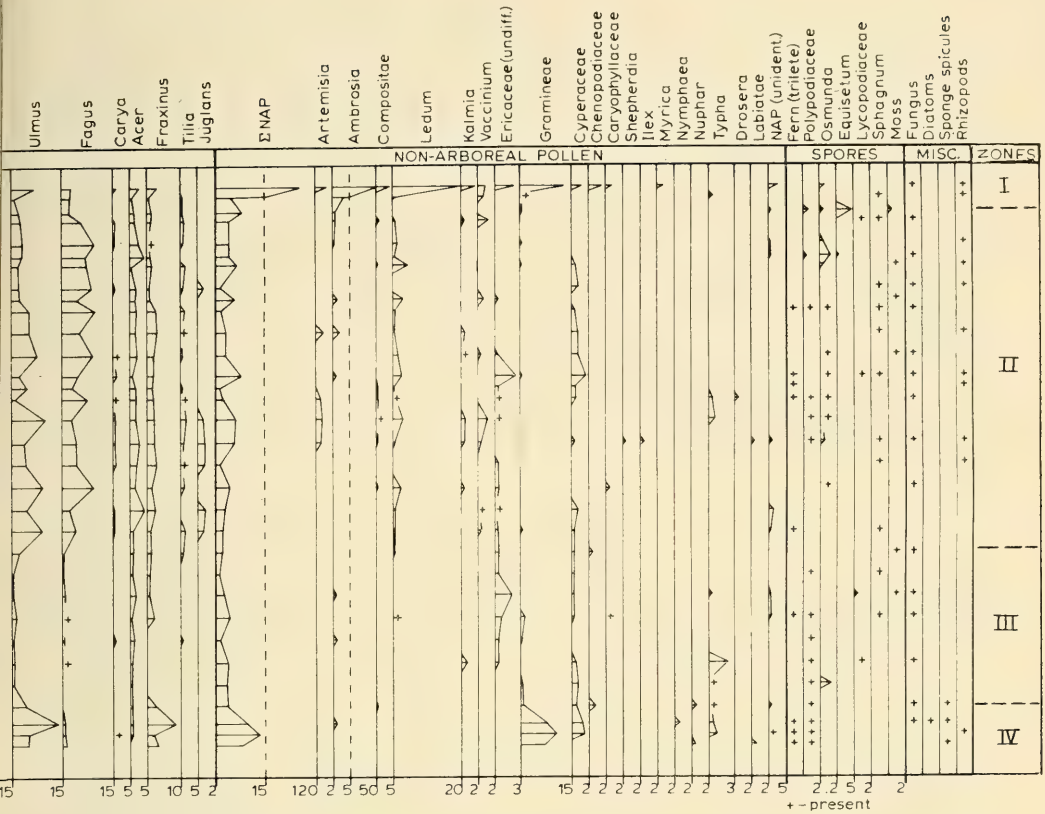


FIGURE 2. Mer Bleue Peat Bog pollen diagram (continued on opposite page).

several diagrams it can with confidence be assumed to represent environmental changes of regional significance. It is therefore possible to establish a series of zones, generally numbered from the youngest to the oldest, the boundaries between each being a time when one of these significant changes took place.

Once these zones are established, more or less empirically, it is possible to deduce something about the nature of the environment, as far as the plants are concerned, during each period. In this way a climatic or environmental history of a region may be established.

Two aspects of this must be clearly distinguished. One is the history of the region as a whole, a region of hundreds of square miles, the other is the history of the Mer Bleue and its immediate vicinity. The regional history may be deduced from features that are common to all or most of the diagrams, the local history must be based on the plants that grew in the bog or its immediate surroundings and reflected special conditions. For it is the local history of these special conditions with which we are concerned. Pollen



records may indicate for instance whether there was much open water present, whether there was a marsh or meadows bordering on the bog, whether the bog was at an early stage of its development or whether it was large and well established.

Origin of the Mer Bleue

In this area, some 11,500 years ago, as the continental ice sheet retreated, the basin that is now the Ottawa Valley was flooded by marine water, forming a body that is now called the Champlain Sea. This sea flooded the Ottawa Valley far to the west of Mer Bleue, later to withdraw to its present position in the St. Lawrence Valley. The Ottawa Valley, left by the withdrawal of the sea, was drained then as now by the Ottawa River, but in its early stages this river flowed through various channels south of its present course (Gadd 1961, 1962). Three of these old channels can be traced in the Mer Bleue, indeed the sample from the bottom of the Mer Bleue core is of silty clay, presumably deposited by the river. The centre channel from which our core was taken is the deepest and after the river shifted its course to the north it did not dry up entirely but part became a lake in which organic material, including pollen, was deposited.

BOTANICAL HISTORY OF THE MER BLEUE

The oldest pollen assemblages show that ash and elm trees grew not far from the abandoned river channel and water lilies decorated patches of open water. Open land was clearly plentiful and contributed abundant grass pollen to the sediments. One of the earliest trees to move in was jack pine (*Pinus banksiana*) a coloniser of open, sandy ground. All this happened (according to our only Carbon 14 date) some 7,500 years ago, and the period of time in this region is designated as Zone IV (see Figure 2). Pollen counts of this zone give no very distinctive clues about the climate at that time. However, the presence of jack pine indicates that the climate was not as cold as it probably was in the immediate post-glacial period not represented in the Mer Bleue diagram. Another pollen diagram of the region that goes back further in time than that of the Mer Bleue (Potzger and Courtemanche 1957) indicates that spruce, which thrives better in colder and damper climates than pine, was then plentiful. By contrast therefore the climate in Zone IV was warmer and drier.

The end of Zone IV and the beginning of Zone III is marked in the pollen diagram by an increase in white pine (*Pinus strobus*)[4] and a slight decline in jack pine. By this time too, the abandoned channel of the Ottawa River had begun to develop into the mire or bog we know today. Cat-tails (*Typha*) grew in the water, Sphagnum moss began to appear, shortly to be followed by plants of the blueberry family (Ericaceae) generally associated with it. Among the Ericaceous pollen grains listed as undifferentiated is at least one that probably came from a leatherleaf (*Chamaedaphne calyculata*). This plant can grow close to open water and indicates an early stage in the development of the Mer Bleue. During Zone III the climate was probably as warm and dry as in Zone IV, as indicated by the abundance of pines, especially of white pine, and a forest, perhaps not unlike the Great Lakes – St. Lawrence Forest of today was established (Rowe 1959).

With the start of Zone II occurs a dramatic change. Hemlock (*Tsuga*) and beech (*Fagus*) become plentiful. Birch (*Betula*), alder (*Alnus*), ironwood (*Ostrya*) and hornbeam (*Carpinus*), elm (*Ulmus*), hickory (*Carya*), maple (*Acer*), ash (*Fraxinus*), basswood (*Tilia*) and walnut (*Juglans*) all seem to have flourished. At present most of these trees seem to be most common south of the Mer Bleue region; and it seems reasonable to conclude that the climate was milder than before, even milder than today. In Zone II also labrador tea (*Ledum*) appeared for the first time. This plant marks a further stage in bog development and the Mer Bleue bog must have been quite extensive by this time.

At the bottom of Zone I both hemlock and beech become scarcer, perhaps the climate was cooling again. In the very top sample of Zone I the entry of the first lumbermen can be detected by their effect on the vegetation. Pine declines, perhaps many stands were cut down, and an increase in birch may show that it was occupying the logged off areas. The great increase in weed

[4]From here on if a genus or species is said to increase, the fact is that the amount of pollen in the samples increases. This is believed to be a valid inference but there may be exceptions.

and grass pollen suggests the presence nearby of cleared land; indeed the tremendous increase of ragweed (*Ambrosia*) is hard to explain in any other way.

During the summer of 1962, under Dr. Terasmae's direction samples of atmospheric pollen and surface peat and bog water were collected (Terasmae and Mott, 1964). When the pollen assemblages thus obtained are compared with the results of the youngest of the bog samples the coincidence is striking. Almost all the trends indicated in the top of the pollen diagram appear to have continued to the present. It would certainly seem that the fossil pollen within the bog gives a reasonably accurate picture of the vegetation of the time, although there are some anomalies. Both spruce and jack pine grow in the Gatineau, a few miles north of Mer Bleue, although the latter is rare. Yet spruce pollen is scarce in the 1962 samples and jack pine pollen is abundant. Perhaps the prevalent westerly wind blows in jack pine pollen from Petawawa, 100 miles northeast of Ottawa where there are large jack pine stands.

Ragweed which had become common with the beginning of Zone I is even more plentiful in the modern samples, reflecting further reduction in the forest cover.

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THE DRAGONFLIES (*ODONATA*) OF THE MER BLEUE

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THE MER BLEUE has been visited by collectors of dragonflies for at least 65 years, and has yielded species of unusual interest. Among the earliest entomologists to catch Odonata there were A. Gibson, C. H. Young, J. A. Letourneau, and J. Fletcher. Those who have collected there subsequently include E. M. Walker, J. McDunnough, F. P. Ide, R. Ozburn, A. W. Richardson, W. J. Brown and ourselves. Knowledge of the distribution and ecology of Canadian Odonata derives to a large extent from the writings of Professor E. M. Walker. For this article we have drawn extensively on his list of Ontario species (Walker, 1941, *Trans. Roy. Canada. Inst.*) and on his treatise "The Odonata of Canada and Alaska" (Walker, 1953, 1958 and in preparation). Our records derive mainly from these published sources, but also from the Canadian National Collection, Ottawa, and from our own observations.

Being an extensive area of spring-fed pools and sluggish streams, with shelter offered by scattered patches of trees, the Mer Bleue offers a favourable habitat for both the aquatic larvae and the winged adults of Odonata. Apart from its general suitability as a habitat for dragonflies, however, it is of particular interest in two respects: it harbours many species typical of acid bogs which are not common elsewhere in this part of Ontario; and (partly because of this) it is a southern outpost for several such species that are otherwise boreal in distribution. Thus the dragonflies recorded from the Mer Bleue are not all of a kind and, as far as our knowledge permits, it will be appropriate to consider them under several heads.

The 14 species that occupy acid, spring-fed, bog pools or streams may be regarded as typical of the Mer Bleue fauna, and they have been distinguished in the accompanying list. Noteworthy among them is *Somatochlora walshii*, which inhabits quiet boggy streams in the Canadian and Transition zones. It was in the Mer Bleue, near Carlsbad Springs, that the larva of this handsome corduliid was first discovered on 5 June 1940. E. M. Walker and T. N. Freeman, after crossing the "moat" at the edge of the bog, came upon a newly emerged male hanging beside the larval skin it had just vacated. Walker had taken an unidentified larva of *Somatochlora* at this same spot 11 years before, and he was now able to show that this also had been *S. walshii*.

Northern or boreal dragonflies, for which the Mer Bleue represents a southerly outpost, are *Williamsonia fletcheri*, *Somatochlora franklini*, *S. kennedyi*, and *Leucorrhinia hudsonica*. All are also inhabitants of acid bog pools. The first-mentioned, the smallest of the Canadian corduliids, is the dragonfly for which this locality will always be best known. The species was described by E. B. Williamson in 1923, from material collected in the Mer Bleue by various Ottawa entomologists, and was named in honour of the late

[1]Contribution No. 2 to the series "Scientific and Cultural Studies of the Mer Bleue" (see CANADIAN FIELD-NATURALIST 83(1):4-6. 1969.

James Fletcher, former Dominion Entomologist and Botanist of the Canada Department of Agriculture. This dragonfly is a glacial relic that inhabits muskegs. At the Mer Bleue its flying season is brief and very early. The larva has never been found.

Some of the resident species are typical of slow streams and rivers, for example *Agrion aequabile*, a striking blue-winged damselfly, and the three gomphids, of which the rare *Gomphus cornutus* is noteworthy. Its range centres around the Great Lakes, embracing Illinois, Iowa, Quebec, Ontario and Manitoba. The first record for Canada came from the Mer Bleue, a male caught by James Fletcher on 18 June 1907; and the only place it has been taken in appreciable numbers in this country since is on the Bear Brook, a sluggish muddy stream at Carlsbad Springs.

Our list may contain dragonflies of two other kinds. There are species of wide ecological valency, such as *Ischnura verticalis*, which is liable to breed in almost any unpolluted body of water. And there are the inveterate wanderers, likely to be caught in most places where Odonata fly, whether they breed there or not. Probable candidates for this latter category are *Tetragoneuria cynosura* and *T. spinigera*, the larvae of which inhabit rocky lakes, but the adults of which may be found in almost any place offering sufficient shelter for them to fly and feed. Within their natural range, they are often encountered far from water, and their presence in collections is no indication that they breed locally. Of course dragonflies, as a group, are strong flyers, and so one must always be cautious about inferring breeding distribution from adult captures alone. But sufficient is known of the Odonata caught at the Mer Bleue to enable us to state that at least 27, and probably 29, of the 32 listed breed there also. Apart from the two *Tetragoneuria* just mentioned, other species which may also have been casual adult visitors are *Epicordulia princeps*, *Libellula lydia* and *L. pulchella*.

A list of Odonata recorded from the Mer Bleue and Carlsbad Springs follows. An asterisk denotes a species typical of acid, bog pools or streams.

ODONATA RECORDED FROM THE MER BLEUE

Zygoptera

AGRIIDAE

Agrion aequabile (Say)

LESTIDAE

Lestes dryas Kirby

COENAGRIIDAE

**Nehalennia irene* (Hagen)
**Enallagma hageni* (Walsh)
E. ebrium (Hagen)
E. antennatum (Say)
Ischnura verticalis (Say)

Anisoptera

AESHNIDAE

**Aeshna canadensis* Walker
**A. verticalis* Hagen
A. constricta Say

GOMPHIDAE

Gomphus cornutus Tough
G. vastus Walsh
G. notatus Rambur

CORDULIIDAE

Epicordulia princeps (Hagen)

Tetragoneuria cynosura (Say)
T. spinigera (Selys)
**T. canis* McLachlan
**Williamsonia fletcheri* Williamson
**Somatochlora walshii* (Scudder)
**S. franklini* (Selys)
**S. kennedyi* Walker

LIBELLULIDAE

**Libellula quadrimaculata* Linnaeus
**L. julia* Uhler
L. lydia Drury
L. pulchella Drury
Sympetrum vicinum (Hagen)
S. semicinctum (Say)
**S. danae* Sulzer
S. obtrusum (Hagen)
**Leucorrhinia hudsonica* (Selys)
**L. proxima* Calvert
L. intacta (Hagen)

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SOME HISTORICAL NOTES ON COLLECTING LEPIDOPTERA IN THE MER BLEUE[1]

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THE collecting of Lepidoptera in the Mer Bleue probably started 100 years ago. However, the first published record of this activity appeared in 1879. On July 19 of that year, 28 members of the Ottawa Field-Naturalists' Club including Dr. J. Fletcher and Mr. W. H. H. Harrington, both of Ottawa, made an excursion to the Mer Bleue to collect insects, plants, and other biological specimens. Numerous butterflies were observed flying in the bog, but no detailed entomological results were given. (1879, Ottawa Field Nat. Club. Trans. No. 1, p.p. 8, 13). Fletcher was one of the founders of that Club and was appointed as the first Dominion Entomologist in 1884, and Dominion Entomologist and Botanist in 1887. Harrington served in the Dominion Postal Service and worked in entomology in his spare time.

Excursions to the Mer Bleue by Fletcher and other members of the Club were annual events from 1879 until Fletcher's death in 1908. These were made

[1]Contribution No. 3 to the series "Scientific and Cultural Studies of the Mer Bleue" (see CANADIAN FIELD-NATURALIST 83(1):4-6. 1969.

by a horse-drawn vehicle, or by a special railway car attached to the Boston Express, operating on what was then known as the Canada Atlantic Railway. The horses were "put up" or the car was detached at Eastman's Springs. This place name was changed to Carlsbad Springs in 1906. It is situated in the western part of the Mer Bleue, about 12 miles east of Ottawa on the present Canadian National Railway.

For many years the mineral springs of the area were considered to contain valuable medicinal properties, and the "Springs" consisted mainly of a hotel for invalids or convalescing patients and those who accompanied them. Even those hardy entomological pioneers "stopped a few minutes to drink the water, and to light the bubbles of gas as they rose to the surface". (Gibson, 1902, Thirty-second Annual Rept. Ent. Soc. Ont. for 1901, p. 110).

The first Lepidoptera recorded from the Mer Bleue were the Bog Copper (*Lycaena epixanthe* Bdv. & Lec.), and the Bronze Copper (*Lycaena thoe* Guer.). These were taken by a few members of the Club on July 1, 1886. A larger excursion was made that year "to Eastman's Springs on 24th July, when some interesting collections were made in the Mer Bleue swamp, and the waters of the mineral springs duly examined and tested". (1887, Ottawa Field Nat. Club Trans. 3: 13, 23).

Perhaps the first significant lepidopteron to be taken in the Mer Bleue was a female of the Jutta Arctic (*Oeneis jutta* Hbn.) collected by Fletcher in June 1888. Fletcher obtained eggs from this specimen and sent them to W. H. Edwards, Coalburg, West Virginia. The resulting larvae enabled Edwards to make descriptions of the immature stages of this species for his classical treatise on the Butterflies of North America (Vol. 3, 1897).

The first new species of Lepidoptera to be recorded from the Mer Bleue was a noctuid moth collected by Mr. C. H. Young, on August 30, 1899, and again in September 1900. The larvae of this species were collected later by Fletcher, Young and Gibson on May 30, 1901, and Young was able to rear some of them to the adult stage. The moths were sent to Prof. J. B. Smith, New Brunswick, New Jersey who named it *Semiophora youngii* (now *Anomogyna youngii* (Smith)). An account of this can be found in a delightful article by Gibson entitled "A Day at the Mer Bleue (Eastman's Springs, Ont.)". (1901, Report of the Entomological Society of Ontario, p. 110). In 1902 Young and Gibson made three trips to the Mer Bleue to investigate the life history of *youngii* because of the considerable injury caused by the larvae feeding on the larch and black spruce.

Years later I had the privilege of becoming personally acquainted with these two men and learned something of the difficulties they experienced on their excursions. One of these difficulties was crossing the wide, natural moat that surrounded the bog. They told me that to cross this they had to wade for 20 minutes in water up to their hips before they could start collecting in the boggy terrain amid the vast hordes of mosquitoes. This emphasizes the enthusiasm and fortitude of our pioneer entomologists, a frame of mind not always present in some of the ankle-wading entomologists of today.

On June 19, 1907, the well-known microlepidopterist Mr. W. D. Kearfott from Montclair, New Jersey, accompanied Fletcher, Gibson and Young to Carlsbad Springs. There they discovered some small larvae boring in the twigs of larch and causing considerable damage. Kearfott reared some adults and named the species *Argyresthia laricella.* (1908, Journal of the New York Entomological Society 15: 182). Later that summer Young made collections in the bog on July 2, 5 and 10, and took 10 specimens of a new crambid moth that Kearfott described as *Crambus youngellus* (1908, Proceedings of the U.S. National Museum 35: 380).

The following year on June 6, 1908, Gibson and Young, accompanied by Mr. Norman Criddle, the renowned naturalist from Treesbank, Manitoba, went to the Mer Bleue and collected three specimens of the rare Bog Fritillary butterfly *Boloria eunomia triclaris* Hbn. (1909, Report of the Entomological Society of Ontario for 1908, page 103). Young collected another specimen of this species at the same locality on June 9, but, to my knowledge it has not been collected there since that date.

The next interesting record from the Mer Bleue was the capture of a specimen of an arctic butterfly the Freija Fritillary, *Boloria freija* Thumb., by Young on June 6, 1911. (1912, Report of the Entomological Society of Ontario for 1911, page 92). This species also has not since been collected from the Mer Bleue. With the death of Fletcher in 1908, and Young's acquisition a few years later of a summer home at Meach Lake, Quebec, (about 15 miles north of Ottawa), the Mer Bleue entered a decade of entomological doldrums. In 1919 Dr. J. H. McDunnough was appointed chief of the newly formed Systematic Unit of the Entomological Branch, Canada Department of Agriculture. He soon became interested in the insect fauna of the Mer Bleue, and as he acquired staff, investigations in the bog became more frequent. Important collections were made by McDunnough, G. S. Walley and W. J. Brown. The collections were added to by F. A. Urquhart and T. N. Freeman, who spent a few weeks in the bog during the summer of 1936. This work did not immediately reveal new records or species but considerably enlarged the meager collections made by the early entomologists and provided specimens for further study.

During the war years 1939-1945, the Mer Bleue was used for military maneuvers and was "out of bounds" to the public. I sneaked in once and experienced a near-miss from a smoke-bomb. Perhaps this was why I didn't visit the bog again until June 1955 at which time I went to find *Argyresthia laricella* Kft., that was discovered there in 1907 and had never been seen since. It was still there and a nice series of specimens were collected.

During the past two summers adults of the rare olethreutid moth *Endothenia daeckeana* Kft. were reared from larvae found feeding on the Pitcher Plant (*Sarracenia purpurea* L.) in the Mer Bleue.

Thus for 85 years the Mer Bleue has continually contributed to the advancement of Canadian entomology, and if left undisturbed, will provide additional knowledge for many years.

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OBSERVATIONS ON OIL POLLUTION AND WINTERING PURPLE SANDPIPERS, *EROLIA MARITIMA* (BRUNNICH), IN NOVA SCOTIA

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DURING the latter half of February, 1967, a section of the Nova Scotia coast line along the Bay of Fundy shore became polluted with bunker oil (Austin-Smith 1968). Rafts of the sticky oil came ashore for several weeks as shifting winds and high tides carried masses of oil-matted rockweed, timbers, and other flotsam up and down the coast. As this was a period of high spring tides, the contaminating oil was spread over a vertical distance of thirty feet (near Digby, Digby Co.) to forty feet (near Scots Bay, Kings Co.) at each successive tide and affected some one hundred miles of shoreline. The authors assume that the equally high tides of late March and April would have re-distributed the masses of oil caked flotsam washed up the previous month. It seems likely that thousands of marine birds could become affected over this extended period. Even on June 9 and July 5 there were patches of wet, sticky oil on the rocks and drift logs at Halls Harbour and Morden.

A number of staff members and students from the Biology Department of Acadia University explored sections of the Fundy shore and collected or recorded at least sixteen species of waterfowl affected by the oil. A visit to this coast just after a high tide would reveal flying birds with dark oil stains; swimming birds unable to fly and in distress; birds sitting on the beach very weak or dying; and other indistinguishable species washed up in the strand line completely encased in a tarry sarcophagus. The effect of such oil pollution is well known for swimming and diving waterfowl, but what we wish to report here is the effect on the habits and habitat of an intertidal shore bird, the wintering flocks of Purple Sandpipers, *Erolia maritima*, that frequent our Fundy shore with notes on feeding ecology and ethology.

Flocks of Purple Sandpipers were seen at Halls Harbour on March 2 and similar observations were made at Port George and Margaretsville on March 11. It is the flock at Halls Harbour upon which our report is chiefly based. The shore line here is basalt and just off a promontory of land east of the community is an isolated pinnacle of rock. On March 2 this pinnacle was surrounded by water at high tide and capped with an ice block formed from frozen spray. Upon this icecap, exposed to the frigid onshore wind, was a flock of thirty-eight sandpipers each standing on one leg and facing into the wind. Six of these birds had dark brown stains on their ventral surface. This characteristic oil contamination of the chest and abdomen and undertail coverts was noted again on March 11. Whereas the larger sea birds actually contact pieces of oil and get matted feathers, the Purple Sandpipers build up a thin coating of oil from wading in tide pools. It was noted later that some

tide pools had patches of oil stuck to the rocks at the water line and that these fed an obvious film of oil into the pool. Other pools had oil on rocks above the water line and these, because of the cold winter weather, flowed very slowly but did contribute an almost indistinguishable film of oil. Rarely did any of the sandpipers have an actual blotch of oil stuck to their feathers. This latter sort of contact could result from their scrambling in and out of the steep-sided basalt rock pools. Both on March 2 and 11 it was noted that these contaminated birds spent a considerable amount of time preening their oil spots. As examination of several collected specimens revealed, the combination of oil and preening eventually matted the feathers and in severe cases the abdominal skin surface was left exposed. We have no evidence that any Purple Sandpipers were rendered flightless by the oil pollution and no dead ones were picked up, but through loss of body heat and ingestion of oil through preening it is probable that losses did occur. However, this would not be of the magnitude of waterfowl mortality due to the great differences between the aquatic habitat (waterfowl), and the high intertidal-spray zone habitat (sandpiper) with their concomitant differences in degree and manner of oil contamination.

At the time of our observations at 1700 hours on March 2 the tide had just begun to recede and there was some flight activity between the "icecap" resting site and a series of tide pools directly below us at the base of a twenty-five foot cliff. From our vantage point we observed nine birds, three of which were resting by the pools and the rest were feeding in typical frantic sandpiper fashion. Two types of feeding behavior were noted. One consisted of moving along unidirectionally following the fissures in the columnar basaltic rock and probing quickly into the damp or flooded crevices. These feeding movements were very rapid and the birds kept moving forward continuously. The second feeding pattern consisted of the birds standing in the tide pools and moving their feet rapidly while remaining in one location, thus disturbing the benthic material and this was immediately followed by feeding in a radial pattern. While feeding, the birds would not allow another within a radius of some twenty-four inches without showing aggressive behavior by running at the intruder for a short distance. This chasing was accompanied by a rapid "twit-wit" note. This suggestion of an individual tolerance distance was also evident by the observation that the members of the flock perched on the ice-covered pinnacle were not huddled together, as might be expected, but were uniformly spaced well apart. Feare (1966) through observing wintering Purple Sandpipers in Britain suggested that aggressive behavior at dusk and following a high tide may be due to intraspecific competition for food.

At least three of the feeding birds had oil stains. These occasionally ceased feeding and while standing half submerged they would alternately preen their feathers beneath the water and then flutter their wings and body and quickly submerge the head and shoulders so that a narrow band of water rolled down their back and sides.

Halls Harbour was revisited in the morning of March 4 but the Sandpipers could not be located. The tide had been ebbing for four hours. A search

of part of the shore line and the tip of the icecap resting site for dead individuals was unsuccessful. The area was examined for oil pollution and in particular the effect on the tide pool habitat, as described previously. Temperature of the water in the pools where the birds had been feeding and bathing on March 2 varied from +0.5°C to −0.75°C depending on the size and position of the pool, vegetation, wind action and presence or absence of ice blocks in the water. The water temperature at the edge of the sea was 0.0°C and several air temperature readings taken at the same time ranged from 0.0°C to +0.5°C.

Examination of the digestive tract contents of five specimens, four of which were collected at Halls Harbour on March 1 by Professor Peter Austin-Smith, Acadia University, and one collected at Margaretsville on March 11 by the junior author, revealed that the locally abundant Northern Rough Periwinkle, *Littorina saxatilis*, formed the major item of prey. Two other larger periwinkles are common in these pools, but only a few fragments of *Littorina obtusata* were identified. No fragments showing the characteristic surface texture of *L. littorea* were located. Fresh specimens of each of these three species of snail were collected for comparison with the stomach contents and when they were crushed it was discovered that *L. saxatilis* and *obtusata* broke with very little pressure, whereas the thick shelled *littorea* required a heavy blow. While Feare (1966) suggested that prey selection is based on prey size, shell hardness may also be an important factor.

The entire snail is consumed and ground to fragments in the gizzard. The only inorganic "gravel" in the gizzard consisted of particles mostly less than 0.5 mm. and only one as large as 2.5 mm. was observed. It is therefore assumed that the snails are crushed one against the other by the powerful gizzzard. The shells are reduced to such fine fragments that only the lower portion of the central columella with parietal lip is intact in the gizzard. Rarely was a complete whorl from the tips of the shell spire identifiable. Some pepper sized fragments escape into the intestine and once in this alkaline medium they apparently continue undigested to the cloaca. The larger columella pieces in the gizzard were 3 mm. long, but nothing of that size ever occurred in the intestine. Are the hard columella pieces retained in the gizzard as "stones" and gradually worn down? Perhaps they are reduced by action of gastric acidity. Certainly some process prevents them from rapidly accumulating and filling the gizzard.

The only other identifiable items of food were a tiny fragment of a barnacle in one bird and the broken plates of a complete barnacle, *Balanus balanoides*, in another. This is the common barnacle species on the Fundy coast. The only other identifiable organic items in the gizzards were pieces of down feathers from the sandpipers themselves. Presumably these were ingested while preening. There was no evidence of oil in the digestive tract.

A check for reports on food habits of this sandpiper revealed a dirth of information for North America. References to specific identification of digestive tract contents were found in Bent (1927) where he quotes two British authors, Yarrell and Witherby. The latter author listed a truly amazing variety of plant and animal matter including grasses, moss, buds and leaves of

phanerogams, seeds, fish, and fish ova. Several genera were mentioned specifically, but no species. Two items included with this list of genera in Bent's quotation of Witherby, namely the orders Amphipoda and Isopoda, are mistakenly italacised as if they, too, were genera. From faeces analysis, Feare (1966) found Purple Sandpiper diet in Britain to reflect the faunal and floral zonation of the intertidal area. Major prey items were molluscs and included *Littorina littorea*, *L. littoralis*, *L. saxatilis*, *Thais lapillus*, *Hydrolica ventrosa*, and *Mytilus edulis*. One gizzard was examined where the most numerous component was *Littorina saxatilis*; this conforms with our Fundy coast gizzard analysis.

It would be interesting to have more data on the winter feeding habits of this unusual sandpiper for they should vary over the species total winter range. For instance, mussels (presumably *Mytilus edulis*) are mentioned as food items by Feare, Yarrell, and Witherby and this species of mollusc is common along much of our Nova Scotia coast line, but extremely rare on the Fundy shore, where these Purple Sandpipers must turn to *Littorina saxatilis* and perhaps *Balanus balanoides* as a staple winter diet. If this sandpiper feeds in the mid-tide and low tide zones to any great extent it would not be in the *L. saxatilis* habitat and would be feeding on different prey species.

There is a definite ecological advantage for this bird to adapt its feeding habits towards *L. saxatilis*. The latter is a high tide and spray zone snail, and is thus available even during extended periods of stormy winter weather. Certainly at this latitude a protected shore line would be covered with ice blocks and very few intertidal species would be exposed. It may be that *Erolia maritima* has to winter on exposed points of coastline for here the shore is kept free of ice by wind and wave, and by the same action the crucial spray zone habitat is extended far above the wash of the waves and allows the birds to feed daily under almost any winter weather condition.

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A HYBRID GROUSE, *LAGOPUS* × *CANACHITES*, FROM NORTHERN ONTARIO

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ABOUT January 15, 1960 Mr. M. Hunter, Chief of the Winisk Band of Indians, shot an unusual grouse while hunting about 15 km south of the mouth of the Winisk River. Not having seen a similar bird before he kept it and gave it to Mr. D. W. Simkin, then District Biologist, Department of Lands and Forests, Sioux Lookout. Mr. Simkin tentatively identified it as a hybrid between a Willow Ptarmigan *Lagopus lagopus* and a Spruce Grouse *Canachites canadensis*. He sent the specimen to the writer who prepared it as a study skin and partial skeleton.

Taverner (1931) recorded a Willow Ptarmigan × Spruce Grouse hybrid taken about 3 km from York Factory on February 16, 1931 and preserved by Ven. Archdeacon R. Faries. Through the courtesy of Mr. W. E. Godfrey I have been able to examine this specimen which is in the collection of the National Museum of Canada. Archdeacon Faries wrote that a similar hybrid was shot in 1930 near Cape Tatnam but was not preserved.

The physiographic characteristics of the Hudson Bay coastal area of Ontario provide habitat conditions for both species in close proximity. The coastal plane has quite recently emerged from the sea and is apparently still slowly rising. The flat bedrock formed of sedimentary limestones carries an over-burden of marine clays and gravels. As the land rises a succession of gravelly beaches are formed which provide narrow strips of well drained soil in the marshy coastal plane. The cold influence of Hudson Bay prevents trees from colonizing the beach lines closest to the coast, but from 1 to 15 km inland tamarack *Larix laricina*, white spruce *Picea glauca* and black spruce *Picea mariana* begin to appear.

Thus, back from the coast there is a series of beach lines with thickets of conifers about their crowns which tail off into a heath-lichen tundra community on the dry level ground surrounding them. Figure 1 is a photograph of the Pipowitan River about 8 km from the Hudson Bay coast. The Spruce Grouse illustrated in Figures 2 and 3 was collected among the spruces on the left side of this picture. Three Willow Ptarmigan were seen among the trees within 100 m of this bird. The autumn plumaged Willow Ptarmigan illustrated in Figs. 2 and 3, was collected on a heath-lichen beach line on the right side of this picture.

The Pipowitan River flows into Hudson Bay about 13 km west of Fort Severn. The interspersion of habitat types in this area is also to be found along the coast east to the Winisk area and west to Cape Tatnam.

The breeding range of the Spruce Grouse *C. c. canadensis* in Ontario extends north to the treed beach lines close to the Hudson Bay coast. The breeding range of the Willow Ptarmigan *L. l. albus* is a strip along the entire

FIGURE 1. Lower Pipowitan River. Spruce Grouse are found in the spruce stands along the river. Willow Ptarmigan range into the spruces but the adjacent heath lichen areas are a more important component of their habitat.

Hudson Bay coast to Cape Henrietta Maria and thence south along the James Bay coast, almost to Lake River. It is on the partially treed beach lines that individuals of the two species are likely to be thrown into close association.

We might enquire into the breakdown of isolating mechanisms which permitted the production of these hybrids. Both behavioral and physiological factors are involved. Although normally monogamous, the pair bond in Willow Ptarmigan is not as strong as that of many passerines and waders. Most hens usually move from one cock's territory to another throughout the winter, finally settling down with one male to nest, occasionally a single cock may have two mates (Watson and Jenkins, 1964).

Under captive conditions, isolated hens have been able to progress in the breeding cycle to the point of laying eggs without the stimulus of courtship from cocks (Watson and Jenkins, 1964).

What is known of the mating behavior of Spruce Grouse suggests that this species is polygamous and there appears to be no pair bond. Mr. V. Saftar writes me that his captive Spruce Grouse hen laid four eggs about 3 weeks after the cock died.

Since the hens of both species have laid in the highly unnatural environment of captivity and those of Willow Ptarmigan without the stimulation of any courtship from a cock, it seems likely that the hens of both species can, in their normal habitats, lay without the stimulation of courtship from a cock of their own kind.

Receptive male Spruce Grouse will attempt copulation with mounted male and female specimens even when the specimens are in a dilapitated condition (Lumsden, 1961). Copulation seems to be evoked by the mount if it is flattened to the ground and motionless.

I know of no published accounts of like experiments with Willow Ptarmigan.

At the receptive stage in the reproductive cycle, captive female Ruffed Grouse *Bonasa umbellus* at the University of Guelph will squat in the pre-copulatory display before humans standing in front of the cage. Captive Blue Grouse *Dendragapus obscurus* have acted in a similar manner at the University of British Columbia (Bendell pers. com.).

Unpublished records in the files of the Department of Lands and Forests indicate that both Willow Ptarmigan and Spruce Grouse fluctuate in numbers in Ontario to a considerable extent. In the Hudson Bay coastal region Willow Ptarmigan can be very scarce some years and Spruce Grouse populations are normally sparse. It seems likely that a female unable to find a mate of her own species might progress in the breeding cycle to the stage of mating. She might perform pre-copulatory displays before a male of the other species even though the evoking stimuli were inappropriate, as in the cases of the female Ruffed and Blue Grouse mentioned above.

It seems equally possible that a male of either species, confronted by a hen performing a pre-copulatory display, even though she was of the "wrong" species, would copulate.

DESCRIPTION OF HYBRIDS

The York Factory Specimen

Nares, some of the feathers black with white tips, others pure white; lores and chin white; a small patch of feathers at the gape and the upper throat black, some of the feathers white tipped; ear coverts grey; streak above and behind the eye white; crown and back of the neck grey, with numerous small black spots and bars; front and sides of the neck white, the bases of some of the feathers black; a narrow band across the upper breast black; the feathers on the rest of the breast, flanks, belly and undertail coverts white, with black bases which show on the sides of the upper breast in a barred and blotched pattern, some of the black patches also appear on the belly; mantle a mixture of bars, streaks and speckles of brown tinged with chestnut, black and grey, some of the feathers on the upper mantle sooty black with grey edging, some white feathers on the side of the upper mantle; lower back and rump brown, barred with black and grey, feathers on the left side of the lower rump broadly tipped with white; lesser upper wing coverts grey, streaked with black and tinged with

FIGURE 2. Dorsal aspect of (left to right) a February and September Willow Ptarmigan; the Winisk hybrid, and a September Spruce Grouse.

brown, speckled with grey and with broad white edges; tertiary coverts dark brown with broad white tips; primaries dark brown with white tips, numbers six to nine (outer ones) with white outer webs becoming speckled with brown toward the tips; shafts dark brown; secondaries and tertiaries dark brown speckled with white with broad white tips, tertiaries tinged with chestnut; upper-tail coverts dark brown with chestnut tinged bars and broad white tips; rectrices sooty black, many of the outer ones with a faint chestnut tinge near the tip and some of the central ones with grey barring near the base; underwing coverts and axillaries white; tarsal feathering dirty white with brown speckles; toe feathering white with much stain.

The Winisk Specimen

Nares black but some of the feathers with white tips; lores and chin white; a patch of feathers at the gape and the upper throat black; ear coverts grey; streak above and behind the eye white; crown and back of the neck grey with some small black marks; rest of the head, front and sides of the neck white; a band across the upper breast black; rest of the breast, flanks, belly and under-tail coverts white, most of the feathers with black bases which do not show;

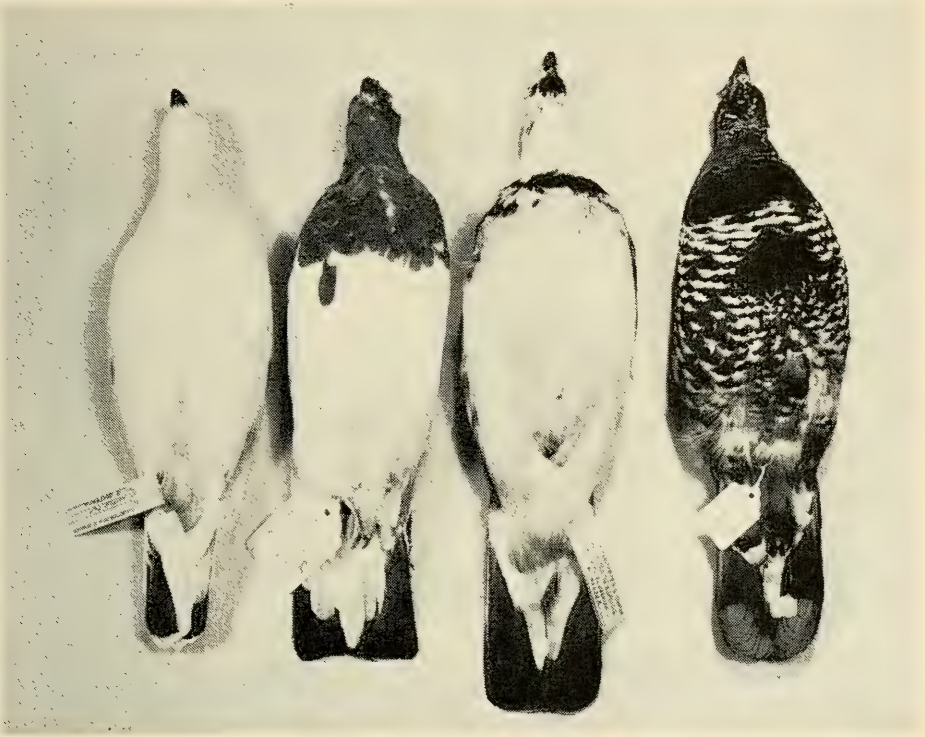

FIGURE 3. Ventral aspect of the same specimens in Fig. 2. The September specimens of the Willow Ptarmigan and the Spruce Grouse were collected close to the river illustrated in Fig. 1.

mantle grey streaked and speckled with black, a few partially white feathers are present and the odd one has some small chestnut markings; lower back and rump grey with broad black transverse bars and chestnut markings replacing the grey on some feathers, some feathers broadly tipped with white; lesser upper-wing coverts and primary coverts sooty black with grey streaks and speckles; secondary coverts white with sooty base streaked and speckled with grey; tertiary coverts grey, speckled with black and with broad white tips; primaries sooty black with white tips; numbers six to nine (outer ones) with white outer webs, becoming speckled with sooty black toward the tips; shafts dark brown; secondaries and tertiaries sooty black speckled and barred with pale grey with broad white tips, some of the inner ones slightly tinged with chestnut; upper-tail coverts, for two thirds to three quarters of their length, grey with black bars and blotches, terminal part black with dark chestnut bars and blotches and a broad white tip; rectrices, upper surface, black with grey speckling, terminal third black, central four feathers with white tip, edge of outer web of outer two rectrices on each side white; under surface of rectrices black; under-wing coverts white with some faint

TABLE 1. — Comparisons of weights and external measurements of male Spruce Grouse, Willow Ptarmigan and the hybrids

	Canachites canadensis canadensis	Hybrids York Factory	Winisk	*Lagopus lagopus albus*
Winter wt	Avg 518 g (10) (468–570)	—	651	Avg 617 g (6) (587–655)
Wing	Avg 175 mm (10) (168–177)	193	197	Avg 203 mm (10) (189–216)
Tail	Avg 120 mm (10) (112–124)	133	139	Avg 120 mm (10) (113–127)

grey speckles; axillaries white; tarsus and toe feathering dense and white; the third tail feather from the outside on the left side has a small chestnut mark on the inner web.

Figure 2 illustrates the dorsal aspects of a male Spruce Grouse, the Winisk Hybrid, and September and February specimens of Willow Ptarmigan.

Figure 3 illustrates the ventral aspects of the same specimens.

Soft Parts of Both Hybrids

In both hybrids the beak is black and although slightly smaller resembles that of the Willow Ptarmigan in curvature of the rostrum and in massiveness.

In both, the terminal joints only of the front toes and the rear toe are bare of feathers, the proximal joints of the toes and the tarsi possess dense feathering which cover the feet almost to the end of the toe nails. Like the Spruce Grouse, the toes carry pectinations throughout their length. In the Willow Ptarmigan these structures are microscopic or absent. The length of the pectinations is variable but some on the central toes are 2.3 mm long; this exceeds the length found on most Spruce Grouse taken in January or February.

In both hybrids the nails are very long and are black turning to horn at the edge and tip and are unlike winter specimens of Willow Ptarmigan in which the nails are yellowish white with black bases.

The specimen from Winisk, taken in 1960, possessed a bursa 21 mm deep indicating that it was a bird of the year. The testes were 5 mm long and appeared to be normal. There is no sex notation on the specimen label (Nat. Mus. of Canada 24742) of the York Factory bird, but, as noted by Taverner, it was probably a male since the black areas on its plumage coincide with those on male Spruce Grouse.

The Winisk specimen has 17 rectrices. A careful check of the specimen before the skin was prepared revealed that none were missing. The extra one is on the left side and is slightly narrower and shorter than its neighbour and the outer feather on the opposite side. The York Factory specimen has 16 tail feathers as do most Willow Ptarmigans and Spruce Grouse.

TABLE 2. — Measurements of the skeletons of male Spruce Grouse, Willow Ptarmigan, and the Winisk hybrid

Element	*Canachites canadensis* 10 specimens	Hybrid from Winisk	*Lagopus lagopus* 10 specimens
Femur	57.7 (55.2–60.0)	63.0	63.8 (61.5–65.4)
Tibio tarsus	72.8 (70.4–75.1)	79.6	80.3 (78.2–82.0)
Tarsus	36.9 (35.4–39.5)	40.3	41.7 (40.7–43.0)
Humerus	54.2 (52.3–56.8)	61.2	63.1 (60.7–64.9)
Coracoid	43.4 (41.7–45.2)	46.8	46.1 (43.4–48.2)
Scapula	61.6 (57.2–63.7)	66.7	64.6 (62.3–66.7)
Sternum (Length of the keel)	79.0 (74.4–82.0)	78.2	75.0 (70.9–78.5)
Synsacrum (width measured from the tips of the lateral processes of the Ilium)	43.9 (41.6–46.1)	50.6	49.9 (47.4–52.8)

In the Willow Ptarmigan the upper tail coverts in the winter plumage are actually longer than the rectrices and, at rest, cover them thus hiding their black color completely. In the hybrids the upper tail coverts end 22 mm and 30 mm short of the tips of the central rectrices. They are relatively longer than those of the Spruce Grouse which end 30 mm to 37 mm from the end of the tail.

Size

In Table 1 a comparison is given of the weights and wing and tail measurements of Spruce Grouse, Willow Ptarmigan, and hybrid males.

The Ptarmigan weights were of specimens of *L. l. albus* collected at Uranium City, Saskatchewan in February and sent to the author through the courtesy of Dr. R. W. Nero. The weights of Spruce Grouse were from Ontario specimens of the race *C. c. canadensis* collected in December, January, and February.

The measurements from the skins and skeletons were all taken from birds collected in northern Ontario. They are in the collection of the author.

It will be seen that the Winisk hybrid was substantially heavier than any of the males of Spruce Grouse and of all but one of the Willow Ptarmigan in the sample.

The wing length of all but one Willow Ptarmigan exceeded that of the Winisk hybrid while only two Willow Ptarmigan were smaller in this aspect than the York Factory specimen.

Table 2 summarizes the skeletal measurements for the Winisk hybrid and 10 each of male Willow Ptarmigan and Spruce Grouse.

The hybrid exceeded the Spruce Grouse series in size in all skeletal elements measured except the sternum. A single cock Spruce Grouse had a shorter sternum keel and one other was the same length.

With the exception of one skeletal element the measurements of the Winisk hybrid lay within the range noted for Willow Ptarmigan. The tarsus was, however, slightly shorter than any of the Willow Ptarmigan in the series.

The femur of the Willow Ptarmigan is not only longer than that of the Spruce Grouse studied, it is also much more heavily built. The Spruce Grouse femur is relatively straight while that of the Willow Ptarmigan is curved. The hybrid shares this character with the Willow Ptarmigan.

Apart from great length and massiveness, the tibiotarsus of the hybrid differs from that of the Spruce Grouse in the relatively greater prominence of the inner and outer anterior crests. It is similar in this respect to the Willow Ptarmigan.

Finally, comparison of the sterna reveals that in the Willow Ptarmigan the margins of the sternal plate are almost parallel. About the narrowest point the width is 10.7 mm; at the posterior end it broadens to 14.5 mm. In the Spruce Grouse the narrowest point measures 11.7 mm and the posterior end flares laterally to 23.2 mm. The hybrid lies between the two, but more nearly resembles the Spruce Grouse in this character, measuring at the narrowest point 11.6 mm and flaring to 20.6 mm at the posterior end.

The Winisk hybrid is larger, in all but one of the skeletal characters measured than any of the Spruce Grouse in the sample. It is larger than the Willow Ptarmigan in the mean in six and smaller than the mean in five of these characters. There is a suggestion here that hybrid vigour influences the size of the Spruce Grouse × Willow Ptarmigan cross. It is not known if these hybrids were fertile.

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INTRODUCTION OF TROPICAL FISHES INTO A HOTSPRING NEAR BANFF, ALBERTA

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In 1924 mosquitofish, *Gambusia affinis* (Baird and Girard), were introduced for purposes of mosquito control into the outflow of Cave and Basin Hotspring, Banff National Park, Alberta. In the summer of 1953 these waters were checked and the presence of numerous schools was confirmed (Mail, 1954).

In response to my request, Drs. A. H. Clarke and E. G. Munroe checked on the status of this population while visiting the Banff area on 1 June 1968. Using dip nets, specimens were collected from a marsh (*see* Figure 1) which is located immediately below and is partly warmed by several outlets of the hotspring, near the Bow River. To our surprise not only *Gambusia affinis*, but the green swordtail, *Xiphophorus helleri* Heckel, and the guppy, *Poecilia* (*Lebistes*) *reticulata* Peters, were collected. Most were preserved (see table 1) but 7 living guppies were brought back (still alive, 15 October 1968). Enquiry revealed that local acquarists had planted tropical fishes and that mollies, cichlids and angelfish were also present. Except for the angelfishes, the fishes were reported to overwinter. It appears that introductions of species other than the mosquitofish must have been made between 1958 and 1967.

At the author's request the Regional Biologist, Mr. J. C. Ward, contacted through Mr. Jean-Paul Cuerrier, made a further collection in the same locality 28 August 1968, in the hopes of securing the other species reported. This collection contained the previously caught species and in addition the all-black variety of the sailfin molly, *Poecilia* (*Poecilia*) *latipinna* (Lesueur) (previously placed in the genus *Mollienesia*) and the convict or zebra cichlid, *Cichlasoma nigrofasciatum* (Günther). Fishes from this collection are shown in Figure 2. None of these species are recorded in Scott and Crossman's (1967) *Provisional checklist of Canadian freshwater fishes*. The only other references to the mosquitofish in Canada are a brief mention in Nelson (1965) to the hotspring introduction and ones in Carl, Clemens and Lindsey (1967) and Smith (1960) which will be mentioned further on. The specimens of the sailfin molly, the guppy, the green swordtail and the zebra cichlid apparently provide the first records for their successful introduction into the waters of Alberta and of Canada.

The number and size ranges of each species in the two collections are recorded in Table 1, with the total number of specimens collected and the total size range. The collections, except for a small sample of each species sent to the Royal Ontario Museum, are catalogued in the National Museum of Natural Sciences, National Museums of Canada, Ottawa. Nomenclature of poeciliids follows Rosen and Bailey (1963). From the table it is apparent that the guppy was most common in the collections, followed by the mosquitofish, the sailfin molly, the green swordtail and the zebra cichlid. The size ranges might suggest

FIGURE 1. Photograph of the location in the marsh where collection NMC 68-163 was made. Photo by Dr. E. G. Munroe.

that all species collected were reproducing, assuming no introductions of small fishes were made during the summer.

The collection site was in the marsh next to the outflow of Cave and Basin Hotspring at 51°10′N, 115°35′W, across the road from the spring itself, about one mile southwest of Banff on the southwest side of Bow River, Banff National Park, Alberta. According to Dr. Clarke the water is 30° C where it exits from the outlet pipe, but 26° C in the swamp where the fish are found. Vegetation is present on a muddy bottom. The current is slight, the water depth 0-8 inches.

In addition, three other introductions of mosquitofish *Gambusia affinis*, into Canadian waters, may be noted. D. L. Smith (1960) records that in May 1958, 50 mosquitofish were released into a pond near the University of Manitoba, Winnipeg, Manitoba. By October there were 3,000, of which 1,000 were removed. In late May of 1959, after the ice had melted it was found that a good population had overwintered and had begun to reproduce. Dr. C. C. Lindsey (*in litt.*, November 15, 1967) wrote me that, according to Dr. Thorstein, Head of the Department of Entomology, these mosquitofish survived for about two winters but in 1961 or thereabouts the pond ("in a private yard near the

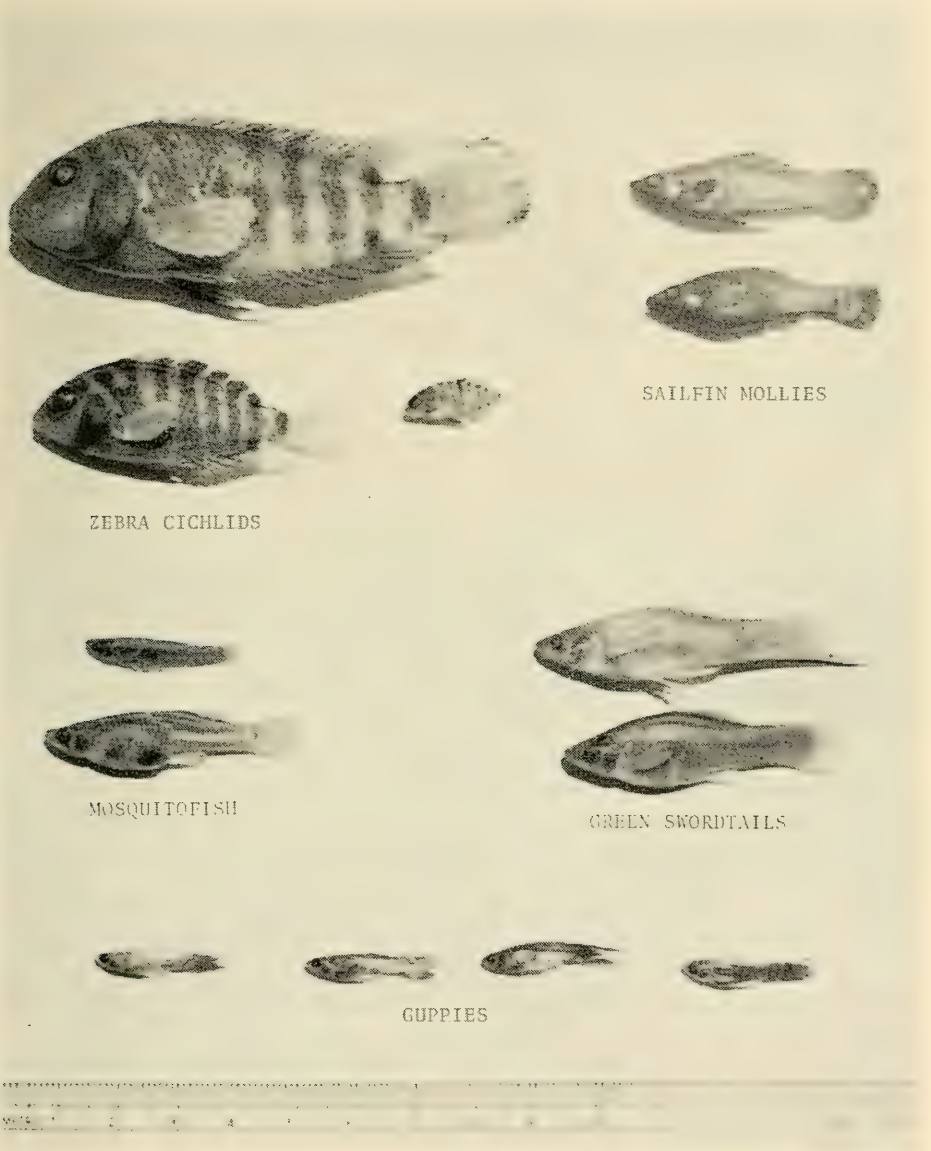

Figure 2. Photograph of fishes in collection NMC 68-301 taken from the outlet of the Cave and Basin Hotspring, Banff National Park, Alberta.

TABLE 1. — Number and size range (mm standard length) of fishes in hotspring collections

Family and species	Collection NMC 68-163 1 June 1968	Collection NMC 68-301 28 Aug. 1968	Total
POECILIIDAE			
Poecilia (*Poecilia*) *latipinna* (Lesueur)	—	13 18.4—35.9 mm	13 18.4—35.9 mm
Poecilia (*Lebistes*) *reticulata* Peters	62 7.8—18.5 mm	396 6.4—29.2 mm	458 6.4—29.2 mm
Xiphophorus helleri Heckel	1 19.0 mm	11 20.4—38.2 mm	12 19.0—38.2 mm
Gambusia affinis (Baird and Girard)	12 + 7 live 14.4—29.2 mm	95 11.0—44.8 mm	107 + 7 live 11.0—44.8 mm
CICHLIDAE			
Cichlasoma nigrofasciatum (Günther)	—	4 15.9—67.6 mm	4 15.9—67.6 mm

old Psychology rat shed") dried out. Carl, Clemens and Lindsey (1967) report that *Gambusia* sp. ? were introduced into ponds in the Kelowna area about 1928, but it is not known if any still survive. Dr. J. S. Nelson (*in litt.*, October 21, 1968) wrote that he had just received two guppies in a collection made by Mr. J. C. Ward from the sulphur hotspring area of Third Vermillion Lake which is about one mile west of Banff and just north across the Bow River from the site of the Cave and Basin collection.

The successful introduction of these tropical fishes so far north of their natural range is of ecological interest. It shows that reproduction and growth has not been inhibited by the different photoperiodism of higher latitudes nor by the different animal and plant life which provide food and shelter. This ecological lability may explain the success of their introduction and as aquarium fishes. Factors also favouring their introduction include the elevated temperature of the marsh and probably the apparent absence of piscivorous fishes. The only other fish recorded from the hotsprings is the longnose dace, *Rhinichthys cataractae* Valenciennes, 1842, noted by Eigenmann (1894) under the name *Rhinichthys dulcis* as very abundant, and by Nichols (1916) as a new subspecies, *Rhinichthys cataractae smithi* (a name, incidentally, omitted from Jordan, Evermann and Clark, 1930). No specimens of the longnose dace were caught in the present collections.

ACKNOWLEDGEMENTS

The author is very grateful to Drs. Arthur H. Clarke, National Museum of Natural Sciences and Eugene G. Munroe, Entomology Research Institute, and to Mr. J. C. Ward, National and Historic Parks Branch for collecting the

specimens, and to Mr. Jean-Paul Cuerrier for his assistance in this matter. Dr. C. C. Lindsey, University of Manitoba, and Dr. J. S. Nelson, University of Alberta, generously provided information on *Gambusia* introductions, Dr. W. B. Scott, Royal Ontario Museum checked the identification and these three along with Mr. Ward and Mr. Charles G. Gruchy, University of Ottawa, kindly criticized the manuscript.

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COLONIES OF DOUBLE-CRESTED CORMORANTS AND WHITE PELICANS IN ALBERTA

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INTRODUCTION

A SURVEY of nesting colonies of Double-crested Cormorants (*Phalacrocorax auritus*) and White Pelicans (*Pelecanus erythrorhynchos*) was made in Alberta during the summer of 1967, as a review of the literature (Thompson, 1933; Lies and Behle, 1966) on these birds revealed that they are declining in number in this province. The survey was conducted by car, boat, and plane.

ACKNOWLEDGEMENTS

Mr. L. G. Sugden, Canadian Wildlife Service, read the manuscript and offered useful comments. Mr. N. Thomas and Mr. C. Scott, Alberta Fish and Wildlife Division, assisted in locating nesting colonies.

RESULTS AND DISCUSSION

Figure 1 depicts that few active nesting colonies of Double-crested Cormorants and White Pelicans remain in Alberta. The letters denoting the location of active and extinct nesting colonies in Figure 1 relate to those in Tables 1 and 2 respectively.

Several of the extinct Double-crested Cormorant and White Pelican colonies disappeared as a result of human disturbance (Farley, 1919; Soper, 1952). Soper (1952) urged sanctuary protection for the pelican colony in Newell Reservoir. No such protection has been given and the nesting population of White Pelicans dwindled at Newell Reservoir from 157 nests in 1951 to 27 nests in 1966 (C. Gordon, pers. comm.). No pelicans nested at Newell Reservoir in 1967. Pelicans started to nest on an island in Lower Therien Lake in June, 1967, but abandoned the location later. There were two nests with

TABLE 1. — Number of nests in active colonies of Double-crested Cormorants and White Pelicans in Alberta in 1967.

Species	Colony location	No. nests
Double-crested Cormorants	C_1 Lower Therien Lake	29
	C_2 Frog Lake	2
	C_3 Newell Reservoir	148
White Pelicans	P_1 Lower Therien Lake	2
	P_2 Namur Lake	153
	P_3 Slave River	ca 50
	P_{3a} Wadlin Lake*	15

*Observed in 1968.

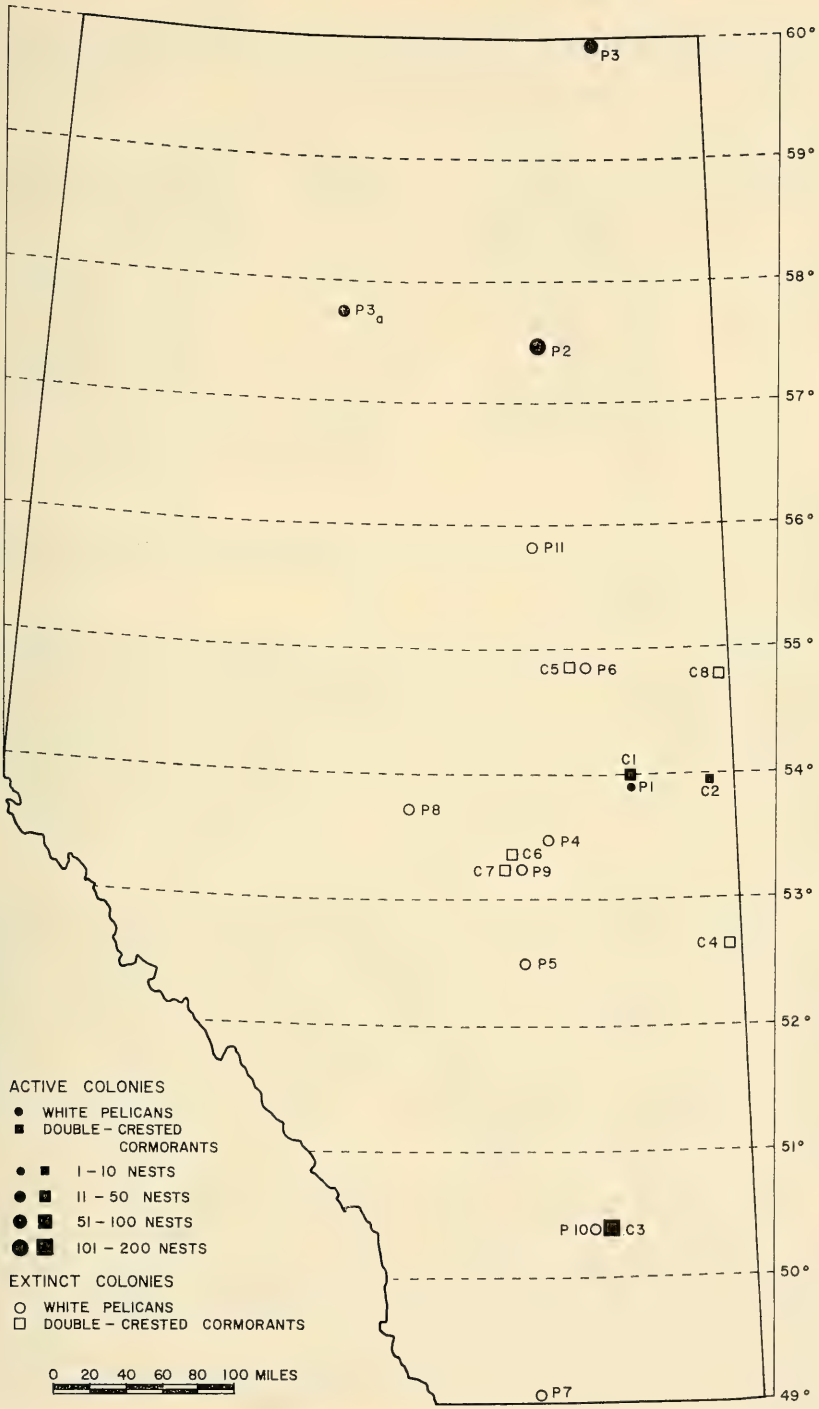

FIGURE 1. Nesting colonies of Double-crested Cormorants and White Pelicans in Alberta.

TABLE 2. — Size of extinct Double-crested Cormorant and White Pelican colonies

Species	Colony location	No. nests	Source
Double-crested Cormorants	C_4 Fresh-water Lake	ca 20	Rowan in Lewis, 1929
	C_5 Lac la Biche	ca 120	Rowan in Lewis, 1929
	C_6 Ministik Lake	ca 12	Horning, 1923
	C_7 Miquelon Lake	—	Farley, 1919
	C_8 Primrose Lake	ca 120	Rowan in Lewis, 1929
White Pelicans	P_4 Beaverhill Lake	81	Lies and Behle, 1966
	P_5 Buffalo Lake	—	Macoun in Thompson, 1933
	P_6 Lac la Biche	—	Farley, 1922
	P_7 Lake Shanks	ca 50	T. Helgeson (pers. comm).
	P_8 Lake Ste. Anne	few	Macoun in Thompson, 1933
	P_9 Miquelon Lake	ca 250	Farley, 1919
	P_{10} Newell Reservoir	157	Soper, 1952
	P_{11} Pelican River	small colony	Preble in Thompson, 1933

young cormorants on a reef in Lac la Biche in 1966, but no cormorants nested there in 1967. There are indications that the birds abandoned these sites as a result of human disturbance.

All colonies of cormorants and pelicans were found on islands. The nests of cormorants were in contact with one another and built on old nesting platforms of previous years. The nests of pelicans were situated directly on the ground either in the open or beneath trees. The clutch sizes of the cormorants at Lower Therien Lake and Newell Reservoir and that of the pelicans at Namur Lake in 1967 are shown in Table 3. The values of the obtained clutch sizes are probably biased as eggs may have disappeared as a result of predation.

The average clutch sizes of Double-crested Cormorants in Alberta in 1967 were within the range of those reported by McLeod and Bondar (1953) for this species at Lake Winnipegosis, Manitoba. Counts by these authors gave an average of 2.43 eggs per nest in 1943, 2.87 in 1944, and 3.63 in 1945. Higher values for the average clutch size of Double-crested Cormorants were obtained by Behle (1958) in Utah and by Drent *et al.* (1964) in British Columbia. Sixty-six nests in both studies averaged 3.9 and 4.1 eggs respectively. Schaller (1964) reported an average clutch size of 1.67 eggs in 212 nests of White Pelicans at Yellowstone Lake, Wyoming. This is a lower average than for this species at Namur Lake, Alberta.

The fledging success could be calculated for Double-crested Cormorants only. The fledging success in 148 nests of this species at Newell Reservoir consisted of 1.9 fledglings per nest. This is a lower average than the 2.4 fledglings produced per nest in 66 nests of this species in British Columbia (Drent *et al.*, 1964). A Double-crested Cormorant colony at Frog Lake in 1967 and one at Lac la Biche in 1966, consisting of two nests each, produced 1.5 fledglings per nest. This shows that small colonies of this species also can reproduce successfully.

TABLE 3. — Clutch sizes of Double-crested Cormorants and White Pelicans in Alberta in 1967

Clutch size	Number of clutches		
	Double-crested Cormorants		White Pelicans
	Lower Therien Lake	Newell Reservoir	Namur Lake
1	2	17	13
2	6	26	54
3	7	23	20
4	12	75	20
5	2	7	
Total	29	148	107
Mean clutch size	3.21	3.20	2.44

SUMMARY

A survey of Double-crested Cormorants and White Pelican colonies was made in Alberta in 1967. Nesting colonies of both species are endangered in Alberta because of human disturbance. The average clutch sizes for Double-crested Cormorants were 2.30 and 2.31 and that for White Pelicans was 2.44. The average fledging success in 148 nests of the Double-crested Cormorants consisted of 1.9 fledglings per nest.

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AUTUMN FLOCKING HABITS OF THE RED-WINGED BLACKBIRD IN SOUTHERN MANITOBA[1]

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BLACKBIRDS (Family Icteridae) customarily gather in flocks after the young are able to fly. The gregarious Red-winged Blackbird, *Agelaius phoeniceus*, is the dominant species in these flocks but is frequently associated with one or more of the following: Yellow-headed Blackbird, *Xanthocephalus xanthocephalus;* Common Grackle, *Quiscalus quiscula;* Brown-headed Cowbird, *Molothrus ater;* Brewer's Blackbird, *Euphagus cyanocephalus;* Rusty Blackbird, *Euphagus carolinus;* Bobolink, *Dolichonyx oryzivorus.* In addition, the Common Starling, *Sturnus vulgaris*, has been observed in flocks of icterid blackbirds. Audubon (1831) reported that certain North American Indians were troubled by flocks of blackbirds feeding in their fields of maize. Recently there has been renewed interest in blackbirds because of the depredation caused by fall flocks on agricultural crops (Mitchell and Linehan, 1957; Neff, 1949; Neff and Meanley, 1957; Bird and Smith, 1964).

In Manitoba, blackbird damage is most severe on ripening crops of oats, barley and sunflowers as a result of the feeding of flocks prior to their departure on migration. Reduction of damage therefore depends on being able to control the flocks, which in turn requires knowledge of the normal behaviour of blackbird flocks. Observations on the daily behaviour of blackbird flocks in southern Manitoba during the summers of 1960 to 1964 are reported.

TIME OF OCCURRENCE OF FLOCKS

Red-winged Blackbirds are summer residents in Manitoba. Small flocks of males begin returning to Manitoba from their winter range late in March or early in April (Mrs. Joan Hochbaum, unpublished data). By the third week in April, the size and frequency of flocks of males has increased greatly. Females first appear during the last week of April. About mid-May the last flocks of either sex arrive in southern Manitoba.

Flocks break up when they reach the breeding grounds. Later, after the young birds leave the nest, flocks begin to form again when family groups of females and young gradually join with other family groups from a breeding area. Throughout July and August these flocks forage in the upland areas near their night roost, which is usually in a relatively large marshy or shrubby area near water. Southward migration from Manitoba begins about mid-August, reaches a peak during the last week of August or the first week in September (Fig. 1), then diminishes gradually and terminates about mid-November.

As the migrating flocks travel southwards from Manitoba through the United States they apparently move from one area of concentration to another

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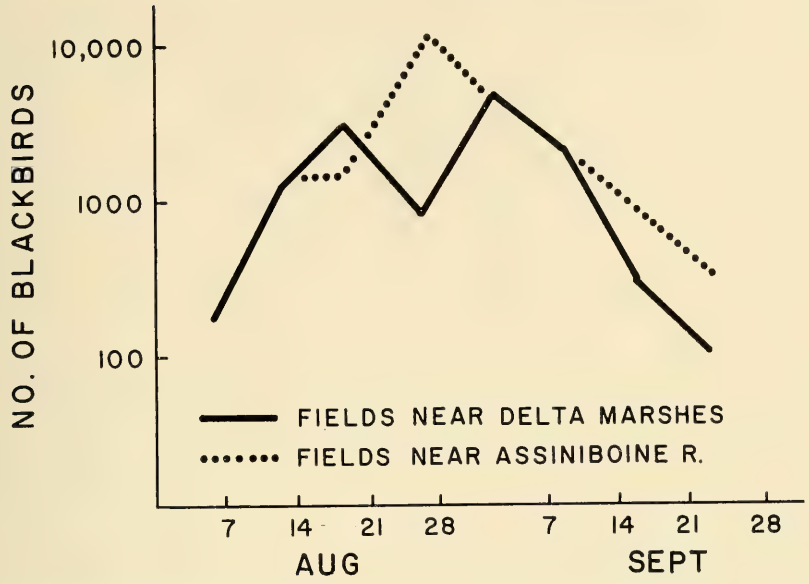

FIGURE 1. Total number of blackbirds seen at weekly intervals during August and September 1964 in two agricultural areas.

(De Grazio, 1961, 1963). From November until February the birds forage daily in the fields in flocks at the wintering sites mainly in Arkansas, Tennessee, and Texas. The wintering populations begin to move northward in late February (Neff and Meanley, 1957).

STUDY AREAS AND METHODS

Blackbird flocks were observed in two agricultural areas in Manitoba, one north of Portage la Prairie and the other near Altona, which were described in detail in a previous paper (Bird and Smith, 1964). Each area, consisting of approximately 80 square miles, was visited once every two weeks from May to October in 1960, usually from 1000 hr. to 1700 hr. C.S.T. i.e. from 5-6 hours after sunrise until 2-3 hours before sunset. The areas were also visited at various times during August and September in 1961, 1962, 1963 and 1964. Observations were made with the aid of 8 x 30 binoculars.

RESULTS

Daily Behaviour of Autumn Flocks

Flocks that form after the nesting season feed on cereal grains, weed seeds, and insects (Bird and Smith, 1964). The daily pattern of behaviour is remarkably consistent. Beginning at sunrise blackbirds leave the communal night roost and fly to nearby fields to feed; after feeding they fly to the nearest water to drink, then rest in trees near the watering spot where they preen themselves, and sing sporadically. This cycle of movements seemed to be repeated throughout the day (Table 1) and about 2 hours before sunset, the birds begin returning to the night roost.

TABLE 1. — Number of blackbirds flying to and from fields in which they fed.

Date	Place	Time (hr) C.S.T.	Birds flying to field per 5 min. interval			Birds flying from field per 5 min. interval		
			Mean	Range	5 min. intervals with no birds	Mean	Range	5 min. intervals with no birds
Aug. 11, 1961	Altona	1400–1630	12.9	1–93	5	9.9	1–63	8
Aug. 9, 1962	Altona	1245–1340	6.9	255+500	9	6.4	70–250	6
Aug. 13, 1964	Portage la Prairie	1145–1300	163	35–620	2	86.1	20–200	2

TABLE 2. — Distance between feeding and resting areas of blackbird flocks in southern Manitoba

Location	Distance from feeding area to resting area (yards)						
	100	150	200	300	400	700	1000
Portage la Prairie	3	3	1	1	0	1	1
Altona	4	3	0	2	1	0	0

During the day blackbirds left the trees in small groups of 10 or less, evenly spaced along a direct line between the trees and the field in which they fed. When the birds ceased feeding, they usually rose in a flock of 50 or more, circled once, and then either flew directly to the trees or split in two parts; one part returned to the crop and the other went to the trees. While the birds were in the field they rose frequently in a flock and either returned to the same spot immediately or moved to another part of the field. The intervals between feeding periods were variable. Most flocks fed within 200 yards of the trees in which they rested (Table 2). However, in the Delta area in October 1960, blackbirds in one flock were observed feeding about 1000 yards from the resting area. The fields in which the birds fed were usually close to a source of water, such as a pond, farm dugout or ditch, with trees and or shrubs nearby.

Sex Distribution in Flocks

In 1964, observations were made on the sex distribution within flocks from two areas of farmland near Portage la Prairie. One area was near the extensive Delta marshes and the other was along the banks of the Assiniboine River. In both areas observations were made weekly from August 13 until September 23. Near the Delta marshes observations were made in fields within ¼ mile of either side of a segment of road running 5 miles south from the edge of the marsh. Two such segments were randomly selected. Observations near the Assiniboine River were made ¼ mile on either side of a highway near the north bank of the river for a distance of 30 miles. The ditches along this highway were deep and had many wet areas with dense growth of cattail, *Typha latifolia* L., that were breeding sites for Red-winged Blackbirds in summer.

The proportion of adult males in flocks near the Delta marshes was higher than in those along the Assiniboine River, irrespective of the size of the flock (Table 3). Conversely, however, Allen (1914) noted that the adult male Red-winged Blackbirds formed separate flocks after the breeding season. In 1960, we observed flocks that contained only adult and sub-adult males from early August to early October. Also in years previous to 1964, some flocks that contained either adult and sub-adult males only, or females and juveniles

TABLE 3. — Estimated proportion of adult males in blackbird flocks from two areas near Portage la Prairie, Manitoba, in August and September, 1964

No. birds in flock	No. weeks	No. flocks	No. adult males	No. females	% adult males
		Near Delta Marshes			
5 – 50	6	9	195	83	70.1
50 – 500	6	4	1609	303	84.1
500 or more	6	3	3590	1910	65.3
		Near Assiniboine River			
5 – 50	6	18	93	369	20.1
50 – 500	6	24	916	2380	27.8
500 or more	6	7	5667	11933	32.2

only, were seen; such flocks occurred less frequently than those that contained mixed sexes and developmental stages.

Size of Flocks

The size of a flock varies greatly throughout the season and throughout the day. A blackbird flock appears to be an open community that can be added to or subtracted from readily. Thus, in a particular area, the size of a flock can change rapidly during the day, yet is unlikely to reflect a change in the total population in the area. Usually feeding flocks contained less than 500 birds (Table 4). However, large flocks (over 500 birds) were observed more frequently in the area north of Portage la Prairie than in the area around Altona (Table 4) and some flocks in the area north of Portage la Prairie in early September were estimated to contain 10,000 blackbirds.

Species Within Flocks

In 1960, the species compositions of 75 flocks was recorded during the period from mid-July until mid-October. Of these flocks 35 contained Red-winged Blackbirds only; the remainder of the flocks contained from 1 to 4 other species. The species and their frequency of representation were:

Yellow-headed Blackbird	33
Brewer's Blackbird	11
Brown-headed Cowbird	2
Rusty Blackbird	1
Common Grackle	1
Bobolink	1
Starling	1

TABLE 4. — Frequency of occurrence of blackbird flocks of different sizes in two areas of Manitoba noted between July 23 and October 19, 1960

Area	No. of flocks		
	5 to 50 birds	50 to 500 birds	more than 500 birds
Portage la Prairie	14	34	10
Altona	15	22	2

Miscellaneous Notes on Flocks

Blackbirds continue to feed in the fields in late July and August during the postnuptial molt. Absence of some primary feathers, absence of tail feathers, or absence of large patches of feathers from the head and body characterized the molting birds. Allen (1914) and Neff and Meanley (1957) noted that during the molt blackbirds either remained in the marshes or in treed and shrubby areas during the day. Our observations showed that blackbirds did not fly far from trees to feed while they were in the period of heavy molt, although they might move a mile or two from the night roost during the day.

Birds entering a field to feed nearly always flew directly to a place where birds were already feeding and either dropped down amongst the feeding birds or flew slightly past them, made a 180 degree turn and then landed.

In late September and October, when most of the fields had been harvested, the birds foraged on either stubble or cultivated fields. Often the flocks moved rapidly across the field with the birds at the rear continually making short flights over the other birds to land at the front of the flock. In flights of more than ¼ mile, the longest axis of most flocks constituted the direction of flight. This is in contrast to observations made by Allen (1914) near Ithaca, New York, that the longest axis of flocks was perpendicular to the line of flight.

An approaching hawk invariably evoked an alarm reaction. The birds rose from the ground or low vegetation as the hawk approached and then circled above the hawk until it passed by. The Marsh Hawk, *Circus cyaneus*, particularly, and to a lesser extent the Sparrow Hawk, *Falco sparverius*, elicited this alarm reaction.

When birds in a flock were shot at with a .22 rifle or a shotgun, they arose immediately and flew to the nearest trees. The sound of an acetylene exploder produced a similar response. Once the birds were in the trees, however, noise alone rarely induced them to leave.

DISCUSSION

Most of the life of an adult blackbird appears to be spent as a member of a flock. Flocks only break up during the nesting season and even then some birds may still continue to feed in flocks. The flocking behaviour of black-

birds appears to have survival value. No doubt blackbirds in flocks are more successful than isolated birds in locating abundant sources of food. Searching efficiency of the flock is particularly important for birds such as these which feed on small seeds (e.g., Setaria sp.) and insects as small as aphids (Bird and Smith, 1964).

In addition to the benefit derived from being able to find a food source initially, other flocks can more readily find concentrations of food by decoying to flocks already feeding. Use of communal roosts permits birds that have arrived recently in the area to follow others to food sources and the habit of feeding in certain areas becomes established.

Birds in flocks have better protection from predators than do individuals because a predator cannot get near a flock without being detected. It is also possible that a whirling flock of birds confuses predators such as hawks.

The most outstanding characteristic of late summer flocks of blackbirds in southern Manitoba was the consistent behavioural pattern associated with feeding. Cessation of feeding was invariably followed by flight to a source of water. The blackbirds then rested and preened themselves in trees and shrubs adjacent to the water. In due course the birds returned to the fields to feed. It is assumed that the stimulus for further feeding was in some manner related to the activity of the gastro-intestinal system and perhaps the fullness of the crop. Blackbirds in late summer usually fed until gizzard and crop were full, particularly before the flight to the night roost.

Voracious feeding by blackbirds at this time of year is accompanied by fat accumulation which serves as an energy reserve during migration. The pattern of feeding behaviour appears to offer an efficient means of storing energy in preparation for migration.

In southern Manitoba, the feeding cycle seemed to be continuous throughout the day. In contrast, Orians (1961) noted with wintering birds in California and Case (1962) noted with migrating birds in New York State that a rest period existed about mid-day which interrupted the feeding cycle.

When more than one species of blackbird was present in a flock, there did not appear to be segregation according to species. Nevertheless, De Grazio (1961) noted that in night roosts, Yellow-headed Blackbirds tended to segregate from other species of blackbirds.

SUMMARY

Flocks of Red-winged Blackbirds that form after the breeding season in southern Manitoba follow a characteristic cycle of movements during the day; flight to a field to feed, flight to water to drink, a period of rest and preening in nearby shrubs or trees, then a return to the field to feed. Flocks usually feed in fields within 200 yards of a source of water near trees or shrubs.

Throughout the post-nesting period flocks of mixed sexes were seen more frequently than those containing either adult and sub-adult males only, or females and juveniles only. Most feeding flocks contained less than 500 blackbirds but where extensive amounts of roosting habitat were available, larger flocks were noted. Red-winged Blackbirds may occur alone in flocks

or in association with from one to four other species of blackbird. The Yellow-headed Blackbird is most frequently associated with the Red-winged Blackbird.

Red-winged Blackbirds are not confined to marshy or shrubby areas while they are in the period of postnuptial molt although they do feed relatively close to this type of cover. When they fly to a field to feed, they usually alight where other blackbirds are feeding. Flocks in flight for more than ¼ mile are usually oriented with the longest axis in the direction of flight.

Flocks exhibit alarm at the approach of hawks and at the sound of a shotgun or a .22 rifle.

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FUNGI OF CENTRAL BAFFIN ISLAND[1]

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Introduction

The Plant Research Institute, Canada Department of Agriculture currently carries a project to study the fungi of the Canadian Arctic. This large geographical area was little known mycologically until 1950 and until 1967 Baffin Island was still poorly sampled.

In 1967, 4 DEW line (Distant Early Warning) sites were used as working bases from which to collect fleshy saprophytic fungi, parasitic fungi and their host plants. All of these sites, except inland plateau Fox 3 are on exposed coastal locations and the opportunity to use the Geographical Branch Camp at Inugsuin Fiord as another base was greatly appreciated because its location, some 70 miles inland from the outer coast, offered habitat protection not found at the other sites.

The sites at which specimens were taken are located from the east to west coasts of Baffin Island approximately at mid length. They are:

Cape Dyer (DYE Main 66°35′N 61°37′W)
Cape Hooper (FOX 4 68°26′N 66°44′W)
Inugsuin Fiord (Geographical Branch Camp 69°37′N 70°02′W)
Dewar Lakes (FOX 3 68°37′N 71°07′W)
Longstaff Bluff (FOX 2 68°56′N 75°18′W)

The time spent at each site was governed by a first impression of the flora and by the weather conditions permitting air travel. Only 3 days each were spent at Cape Hooper and at Dewar Lakes and about one week at each of the other sites. In this time some 500 specimens (phanerogamic and cryptogamic) were collected including some soil samples for future determination of soil fungi. In addition 450 specimens of mosses were made by J. R. Seaborn who assisted in the 1967 program.

The mycological specimens are deposited in the National Mycological Herbarium (DAOM) and many will be distributed in our normal exchange program. The vascular specimens are deposited in the Phanerogamic Herbarium (DAO); both herbaria are in the Plant Research Institute, Central Experimental Farm, Ottawa.

General Observations

On arrival at Cape Dyer on July 14, the plateau level of the lower camp was covered with up to 3 ft. of snow. Collecting was limited to southwest facing slopes leading to Sunneshine Fd. and plant growth was more advanced nearest the fiord and sea level. One week later and 200 hundred miles west at Cape Hooper, essentially the same snow conditions were experienced. Again collecting was limited to southerly exposures. Just four days later at the head of Inugsuin Fiord some 120 miles northwest of Hooper snow was

[1]Contribution No. 700 of the Plant Research Institute.

absent although Lakes 1. and 2. were partly ice-covered and plant growth was considerably in advance of that seen at the other sites. Plants of the base camp area have been listed by Hainault (1966). To this list can be added:

Carex marina Dew.
C. membranacea Hook.
C. ursina Dew.
Juncus albescens (Lge.) Fern.
J. arcticus Willd.
Eriophorum triste (Th. Fr.) Hadac
E. vaginatum L. ssp. *spissum* (Fern.) Hult.
Puccinellia langeana (Berk.) Th. Sør.
Ranunculus sulphureus Sol.
Anemone parviflora Michx.
Draba hirta L.
Hippuris vulgaris L.
Saxifraga aizoides L.
S. nivalis L.

All but 5 of the above species were earlier recorded for the Isortoq Fiord area by Webber (1964) and their occurrence at Inugsuin Fiord was to be expected.

The flora of the east coast sites and the Dewar Lakes site is generally similar. Only at the west coast site of Longstaff Bluff did additional species appear. Here were found additional Leguminosae (*Astragalus alpinus* L., *Oxytropis maydelliana* Trautv. and *O. arctobis* Bunge) and Compositae (*Matricaria ambigua* (Ledeb.) Kryle., *Senecio congestus* (R.Br.) DC., *Chrysanthemum integrifolium* Rich.) These elements occur farther west along the mainland coast. A comparison of plant lists by Hainault and Webber (op. cit.) supports my general impression that the western coast of Baffin Island supports the richer flora. A number of causes may be responsible for this and a probable main factor is the slightly ameliorated climate. Accompanying an increase of species in the west will be an increase in the associated parasitic fungi.

THE FUNGI

In the following annotated list, the fleshy fungi (Agaricales) have been identified by J. W. Groves and Sclerotinias were named by Mary E. Elliott. The collection numbers are those of the author.

FUNGI IMPERFECTI

Cladosporium herbarum (Pers.) Lk. on *Poa arctica* R.Br. (3998 c Inugsuin). Primarily saprophytic following heavy incidence of mildew. A common saprophyte on a wide range of hosts.

Cylindrosporium serabrankowii (Bub.) Bub. on *Astragalus alpinus* L. (4042, 4151 Longstaff) and on *Oxytropis maydelliana* Trautv. (4150 a Longstaff). The latter is a new host for this parasite.

Phyllosticta sp. on *Oxytropis maydelliana* Trautv. (4150 b Longstaff). Temporarily assigned to *Phyllosticta*.

Selenophoma drabae (Fuckel) Petrak. (=*Selenophoma donacis* (Pers.) Sprague var. *stomaticola* (Baeuml.) Sprague & Johns.) on *Arctagrostis latifolia* (R.Br.) Griseb. (4051 b Longstaff). This fungus has a wide host range including many Cruciferae. The above grass is thought to be a new host.

PHYCOMYCETES

Peronospora parasitica (Pers.) Fr. on *Eutrema edwardsii* R.Br. (4070 b), on *Draba* sp. (4084), on *Cochlearia officinalis* L. (4147) all from Longstaff. Occurs on the undersurface of leaves of these and other Cruciferae in the arctic.

ASCOMYCETES

Cenangium arcticum Ehrenb. ex Fr. on *Cassiope tetragona* (L.) D.Don (3787 b Cape Hooper). Saprophytic on stems from previous season.

Erysiphe graminis DC. ex Mérat on *Poa arctica* R.Br. (3998 Ingusuin and 4021b, 4035 Dewar Lakes). Fairly common, known on other grasses and regularly associated with rust infection.

Helvella leucomelaena (Pers.) Nannf. On moist bare soil at sea level (4122 Longstaff). A fleshy discomycete, or cup fungus, black-brown and deeply cup-shaped.

Helvella queletii Bres. on disturbed wet gravel near airstrip (4087 Longstaff). Size: 1-4 cm. diam., color: dark brown.

Isothea rhytismoides (Bab. ex Berk.) Fr. on *Dryas integrifolia* M. Vahl. (3937 b Inugsuin and 4039 b Longstaff). Causing locally heavy infection at both sites. This fungus ranges widely in the northern hemisphere and is known only on *Dryas*.

Mycosphaerella chamaenerii Savile. stat. conid.: *Ramularia chamaenerii* Rostr. on *Epilobium latifolium* L. (4111 b Longstaff).

Mycosphaerella saxifragae (Pass.) Lind on *Saxifraga foliosa* R.Br. (3885 c Inugsuin).

Peziza melaleuca (Bres.) Seaver. On disturbed wet gravel in close proximity to *H. queletii;* readily distinguished by smaller size, 1.0 cm. diam. or less, and darker color (4088 Longstaff).

Rhytisma bistortae (DC.) Rostr. on *Polygonum viviparum* L. (4157 C. Dyer). Symptoms as in the following fungus but found only rarely.

Rhytisma salicinum (Pers. ex Fr.) Fr. on *Salix arctophila* Cock. (4009 c Inugsuin, 4022 b Dewar L., 4091 b, 4133 Longstaff) and on *S. herbacea* L. (3930 Inugsuin, 4092 c Longstaff). Infection was usually heavier on *S. arctophila.* Widespread throughout the arctic and subarctic on numerous species of willow. The raised, black shiny fructifications on young leaves are easily observed. Maturity occurs over winter and ascospores are produced on necrotic leaves one to three years old.

Sclerotinia vahliana Rostr. on *Eriophorum angustifolium* Honck. (3894 Inugsuin, 4085 Longstaff), on *E. scheuchzeri* Hoppe (3807 b C. Hooper). Some general comparisons between *S. dennisii* Svreck and *S. valhiana* have been given by Savile and Parmelee (1964).

Scutellinia armatospora Denison among mosses on disturbed wet gravel, locally common (4086 Longstaff). The hymenium of this small discoycete is bright red.

Sphaerotheca fuliginea (Schlecht. ex Fr.) Pollaci on *Braya purpurascens* (R.Br.) Bunge (4071 b Longstaff). This powdery mildew was found only on *Braya* but is recorded on other Cruciferae and indeed other families.

BASIDIOMYCETES (Ustilaginales)

Anthracoidea elynae (Syd.) Kukk. var. *elynae* on *Kobresia myosuroides* (Vill.) Fiori & Paol. (3862 b, 3986, 3987 Inugsuin and 4191 C. Dyer.). A very common smut of the achenes.

Anthracoidea rupestris Kukk. on *Carex rupestris* All. As above the achene is replaced by a black ball of smut spores.

Schizonella elynae (Blytt) Liro. on *Kobresia myosuroides* (Vill.) Fiori & Paol. (4192). This leaf smut is known also from one alpine region in British Columbia. It is rarely collected and apparently this is the most northerly Canadian record.

Ustilago bistortarum (DC.) Körn on *Polygonum viviparum* L. (3841, 3842 Inugsuin; 4031 Dewar L.; 4158 C. Dyer). Occurs widely over the range of the host and in three distinct phases which have been treated also as varieties or even species. The phases are: inflorescence smut, leaf blade smut and leaf margin smut. Collections 3841 and 3842 from the same colony are the inflorescence and leaf blade phase respectively, supporting an earlier suggestion (Savile and Parmelee 1965) that the three phases are but a single species.

Ustilago vinosa Berk. ex Tul. on *Oxyria digyna* (L.) Hill (3924, 3946 a Inugsuin; 4135 Longstaff; 4159 C. Dyer). This inflorescence smut was found wherever there were good-size colonies of the host. All sites were moist but not wet, often located below a snow-drift.

Ustilago violacea (Pers.) Roussell var. *violacea* on *Silene acaulis* L. var. *exscapa* (All.) DC. (3929 Inugsuin, 4190 C. Dyer); and on *Stellaria edwardsii* R.Br. (3872 b,

4008 Inugsuin). Using hosts as a basis, this anther smut on *S. edwardsii* may be identified as *U. violacea* var. *stellariae* (Sow.) Savile. Observations of smut spores do not confirm this – their size intergrades with var. *violacea* indicating a need for additional study of this complex.

BASIDIOMYCETES (Uredinales)

Chrysomyxa ledi (Alb. & Schw.) deBary var. *rhododendri* (deBary) Savile on *Rhododendron lapponicum* Wahlenb. (3943 b, 3989 Inugsuin). The host occurred sparingly at Cape Dyer and was not rusted. It was common on the dry protected slopes at the head of Inugsuin Fiord and rust infection was moderately heavy. We have one specimen from Frobisher Bay – the only other collection from Baffin Island. This and the following species of *Chrysomyxa* are examples of heteroecious rusts existing successfully far from their alternate host in this instance, 350-800 miles north of *Picea*. Spread over such a distance can be explained using this species as an example: once established from the closest *Picea*, the uredinia build up on *Rhododendron* and repeat on adjacent plants. From the west, south or east urediniospores could survive the 100-150-250 mile aerial dispersal from Southampton I., Ungava or Greenland to Baffin Island and continue spread from *Rhododendron* to *Rhododendron*. If this is so, rust may be found on *Rhodendron* to its limit in northern Baffin.

Chrysomyxa ledicola (Peck) Lagerh. on *Ledum palustre* L. var. *decumbens* Ait. (3846 b, 3980 Inugsuin, 4028 Dewar L.: 4041 Longstaff). There was heavy infection at all collecting sites and these are at the northern limit of the host (Porsild 1957).

Chrysomyxa empetri (Pers.) Schroet. on *Empetrum nigrum* L. (4000 b, Inugsuin; 4103, 4143 Longstaff). Light to heavy infection was encountered. Porsild (1957) shows widely dispersed host records north of 70° lat. and these rust collections may be at the northern limit of the rust.

Melampsora epitea Thuem. on *Salix arctica* Pall. (3706 b C. Dyer), on *S. arctophila* Cock. (3700 a, 3743 C. Dyer; 3996 C. Hooper; 4022 c Dewar L.; 3864 b, 4009 b Inugsuin), on *S. herbacea* L. (4019 b Dewar L.; 4092 b Longstaff), on *S. reticulata* L. (3882 b, 3931 b Inugsuin; 4074 b, 4129 b Longstaff) on *Salix* sp. (3835 a Inugsuin). The aecial state occurs on *Saxifraga* in the arctic, but was not found. In the high arctic the rust generally overwinters in the buds of *Salix* and survives without host alternation. Comparison of urediniospores originating from the different *Salix* spp. shows slight differences but extensive study of the complex is required before such characters can be used in any taxonomic revision.

Puccinia arenariae (Schum.) Wint. on *Cerastium alpinum* L. (4052 b, 4148 b Longstaff). Widely distributed throughout the world on Caryophyllaceae. It is especially widely represented in DAOM from alpine and subarctic regions.

Puccinia bistortae (Strauss) DC. on *Polygonum viviparum* L. (3702 b C. Dyer; 3843 a, 3973 Inugsuin). Both uredinia and telia were present on young plants recently emerged from snow cover when collected on 14 July.

Puccinia eutremae Lindr. on *Cochlearia officinalis* L. (4146 Longstaff). Infection was heavy on young plants otherwise only moderate in protected habitats along the rocky coast. Other susceptible Cruciferae include *Eutema edwardsii*. Our rust records do not extend farther north although hosts are amply recorded from the high arctic.

Puccinia pazschkei Diet. var *tricuspidatae* Savile on *Saxifraga tricuspidata* Rottb. (4145 Longstaff). The host is a wide ranging arctic-alpine species with which the rust is nearly coextensive.

Puccinia poae-nemoralis Otth. ssp. *poae-nemoralis* on *Poa ?arctica* R.Br. (4040 a Longstaff). The host was locally common and just lightly infected with rust. As is usual for this species, only uredinia were present on the leaves.

Puccinia pedicularis Thuem. on *Pedicularis flammea* L. (4160 b C. Dyer). This is the first North American collection of this microcyclic rust. It was found only once, and then sparingly, although searched for diligently at all collecting sites. This rust is known also from northeast Greenland on the same host.

BASIDIOMYCETES (Exobasidiaceae)

Exobasidium vaccinii Wor. var. *vaccinii* on *Cassiope tetragona* (L.) D.Don (4020 b Dewar L; 4114, 4152 Longstaff; 4189 C. Dyer).

Exobasidium vaccinii – uliginosi Boud. var. *vaccini-uliginosi* on *Vaccinium uliginosum* L. (3829 a Inugsuin, 4104 b Longstaff). *Exobasidium* is parasitic on leaves

and is readily recognized. Leaves are slightly enlarged, often reddened and covered by a downy bloom formed by the fungus. The first species recorded here is common and widely distributed throughout the arctic; the second is mainly at low-arctic and subarctic sites.

BASIDIOMYCETES (Lycoperdales)

Calvatia cretacea (Berk.) Lloyd on soil in various plant associations. (3732, 3773, 3776 C. Dyer; 3907 Inugsuin; 4018 Dewar L.; 4090 Longstaff). A common puffball, often abundant; in 1967 found up to 8.5 cm. diameter. It is edible when young.

BASIDIOMYCETES (Agaricales)

These fleshy fungi are associated with a soil habitat where there is some decaying organic material. Occasionally they are associated with living plant material, although usually not as a parasite (cf. *Leptoglossum lobatum*). Many are edible, some doubtfully so and some are poisonous. Notes about edibility are based on remarks by Singer (1962) and Groves (1962). Identifications herein are by Dr. J. W. Groves.

Amanitopsis inaurata (Pers.) Fayod. (3962, 3992 Inugsuin; 4172 C. Dyer). Scarce on moist slopes. Cap or pileus is silvery brown, shiny but not sticky. Widely distributed in Canada. Singer considers this in the genus *Amanita* which has a number of poisonous species.

Clitocybe luteovitellina (Pilat & Nannf.) Bigelow (3888, 3890 Inugsuin). Associated with sphagnum and having a predominantly northern distribution. Cap is pale yellow.

Clitocybe umbellifera (Fr.) Bigelow. (3772 C. Dyer). Widely collected in the arctic and often associated with mosses.

Cortinarius sp. (3731 C. Dyer; 3825 C. Hooper; 3886, 3975, 3994 Inugsuin).

Galerina vittaeformis (Fr.) Singer var. *vittaeformis* f. *tetraspora* (3887 Inugsuin). There is one previous Canadian collection in DAOM from Victoria, B.C. The genus contains edible and poisonous species and is therefore not widely used as food.

Hebeloma hiemale Bres. (3910, 3993 Inugsuin). Specimens in DAOM are mostly from northern Canada, a few from Ontario, and are often from an association with *Dryas*.

Hebeloma ?sordidulum (Peck) Sacc. (3749 C. Dyer; 3889, 3974 Inugsuin). These specimens are from *Cassiope* heaths and all specimens in DAOM are from north of tree line. According to Singer (1951) the species concept of the genus is not clear. At least one species is known to be poisonous.

Inocybe ?lorillardiana Murr. (4171 C. Dyer). Arctic collections in DAOM are often but not always from a *Dryas* association.

Laccaria tetraspora Singer (3775 C. Dyer). There are only 3 specimens in DAOM all from sandy habitats. Not among the species listed as being edible.

Lactarius speciosus Burl. (4153 Longstaff). Most species of *Lactarius* are edible but Groves (1962) warns that those with an acrid taste should be avoided.

Leptoglossum lobatum (Pers. ex Fr.) Ricken (4170 C. Dyer). This is a common fungus in the arctic, always growing parasitically on mosses. It is of doubtful food use — pileus, or cap, very thin.

Omphalia onisca Fr. (3823, 3286 C. Hooper). Both collections are from lowlying wet sand. Fructifications small and poorly represented in DAOM.

Russula flava Rom. (4045 Longstaff). Rare on a grassy, stony beach. The slimy and sticky yellow pileus in this collection up to 6.0 cm. diameter. Common in wooded regions of Canada and U.S.A. Most *Russula* species are edible — Singer names *R. foetans* as being probably slightly poisonous. Groves reports *R. flava* as edible.

Russula fragilis Fr. (3958 Inugsuin). The cap is pale pink, tinged red, smaller than *R. flava* and with a like distribution. Groves considers the edibility of this species as doubtful.

Russula nigrodisca Peck (3908, 3976, 3990 Inugsuin; 4117 Longstaff). In this species the cap becomes bright red. During August of 1967 the fructifications became almost abundant on some slopes and moist areas.

Russula venosa Vel. (3959 Inugsuin). The cap is dark orange-red. The fungus was growing adjacent No. 3958 in a wet runnel. Both fungi were rare at this site.

Stropharia aeruginosa (Curt. ex Fr.) Quél. (3909 Inugsuin). The cap is yellowish green. Some species in the genus are considered edible but are rarely eaten. Groves indicates that this species is reported to be poisonous.

Many saprophytic Ascomycetes and Fungi Imperfecti have been removed from 1, 2 and 3 year old stems and leaves of numerous plants. These await future study.

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Gulls at Fredericton, New Brunswick

In the period 1960 to 1968 sight records of nine gull species were obtained at Fredericton, N.B. Five of these had not hitherto been observed inland in the province. Fredericton is located at 45° 58′N, 66°39′W on the Saint John River, about 80 river-miles from its mouth on the Bay of Fundy. Following is an annotated list.

Glaucous Gull *Larus hyperboreus*. I have seen this winter gull at Fredericton on several occasions: one bird frequently from November 6 to 30, 1961 (seen also by D. S. Christie, N. R. Brown); one from October 25 to November 15, 1964 (seen also by D. S. Christie); one on November 20 and 27, 1966; and one on December 3, 1967. All were buffy in color and among other gulls of different species. This bird is uncommonly seen along the coast in winter. Before the 1961 record it was unknown inland in New Brunswick.

Iceland Gull *Larus glaucoides*. I have noted one or more of this species regularly each fall from 1961 to 1967. Dates range from October 17 (1965) to December 7 (1962). Most birds were immature ones in the buffy plumage. Two spring records are as follows: one seen by D. S. Christie and me on April 22, 1963, and one by O. Washburn on May 8, 1966. Squires (1952) reports it a "Not uncommon winter resident along the coast." Like *L. hyperboreus* it was unknown inland here before 1961.

Great Black-backed Gull *Larus marinus*. This species may be seen from soon after the river ice breaks up in the spring until the fall freeze-up. Numbers are usually small, with a slight increase in the fall.

Herring Gull *Larus argentatus*. This is the commonest gull at Fredericton and occurs throughout the ice-free part of the year. Earliest opening and latest closing dates of the river at Fredericton are March 19 and December 31. A few birds, presumed to be non-breeders, are present throughout the summer. Concentrations of up to 100 may be seen in the fall.

Ring-billed Gull *Larus delawarensis*. Transient ring-bills occur fairly regularly in small numbers in spring and fall. Seasonal dates are as follows: April 7 (seven seen in 1965 by D. S. Christie) to May 16 (one noted by the same observer in 1962), and August 21 (one seen in 1961 by A. A. Dean, two seen three days later by D. Gibson) to November 6 (one noted by me in 1966). I saw nine on August 25, 1968. Squires (1965) notes that during the last week in June 1965 H. Chiasson found ten pairs nesting at Bathurst. This constituted the first known breeding record in the province.

Laughing Gull *Larus atricil'a*. An immature representative of this southern species was at Fredericton from September 15 to 25, 1960, and was seen by A. A. Dean, D. K. Parr, I. W. Varty, and others. Hurricane "Donna" had buffeted the region two days earlier. At the mouth of the Nashwaak River on August 25, 1968, I saw an adult in molt. The only known breeding area in the province is the Grand Manan archipelago where Moses (Pettingill 1939) saw three between 1925 and 1930. On the authority of O. Hawksley, Palmer (1949) stated that two pairs nested in 1948 on nearby Machias Seal Island. On a visit to this southernmost outpost of New Brunswick in August 1966, K. F. Edwards and I were informed by one of the light keepers that two pairs had bred there that year. We saw one bird of this species during our visit.

Bonaparte's *Gull Larus philadelphia*. Small numbers occur fairly regularly in spring and fall. Seasonal dates are April 29 to May 17, and August 5 to November 5.

Black-legged Kittiwake *Rissa tridactyla*. I saw an immature of this species on November 26, 1961. My identification

was confirmed by A. A. Dean and N. R. Brown. Squires (1952) refers to its common occurrence in the Bay of Fundy in the fall and winter. It was the first inland record in New Brunswick: its presence at Fredericton could not be attributed to any weather disturbances at the time.

Sabine's Gull *Xema sabini*. A. A. Dean, O. Washburn, and I saw a gull which we identified as an immature Sabine's at Fredericton on October 22, 1966. We kept the bird under almost continuous observation for over three hours, for most of which time it was at rest on the water. In flight the striking wing pattern was most apparent. The bird was in very close company with a Bonaparte's Gull the whole time. Side by side on the water the two birds appeared identical in size. All the details of plumage depicted in Snyder's (1957) illustration were noted. There had been strong winds from the northwest for several days before its arrival. Squires (1952) refers to the casual status of this gull in New Brunswick, citing one specimen taken and two sight records between 1878 and about 1926, all in or near the Grand Manan archipelago.

The diversity of gull species records in Fredericton is chiefly attributed to two factors. First a local naturalists' organization was formed in 1959. Channels for the rapid communication of information concerning sightings were soon developed. The stretch of river on which most of the gull observations were made was for several years probably the most continuously and intensively covered of any area of like size in the province. Second, nearly all the gulls reported were seen in the vicinity of a sewer outlet.

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Range Extensions of *Listera auriculata* Wiegand in Ontario and Quebec

Among orchids native to Canada the genus *Listera* is represented by a few species of which *L. cordata* (L.) R.Br. is widespread and not infrequent, though scarcely common. The other species tend to be northern and western, (except for *L. australis*, a southern plant) and are best described as rare and local. *Listera auriculata* has been recorded previously in eastern Canada only from a few locations north of Lake Superior, in the Clay Belt, the Mingan Islands in the Gulf of St. Lawrence, and farther east, north and west. It was therefore of considerable interest when routine field work for the Ottawa Field-Naturalists' Club survey of native orchids turned up two new sites for this species in Southern Ontario and Quebec. The locations are:

1. *Gatineau Park, Quebec* (near Ottawa, Ont.) Lat. 45°31'N, Long. 75°53'W

This rugged area of Precambrian rock is maintained as a natural park, and except for few roads and ski trails is mainly wild and little disturbed in recent decades. *Listera auriculata* was found growing in moist soil a few feet from a brook which certainly floods the plants during spring run-off. The site is forested with mixed cover which includes hemlock and

black birch. There were only three plants of the orchid, two in full bloom on 25 June, 1968, and one seedling.

A single flower has been preserved in alcohol in the National Herbarium of Canada, Ottawa (CAN), and photographs of the largest plant have been deposited in that herbarium and that of the Research Branch, Department of Agriculture, Ottawa (DAO).

2. *Barry's Bay, Ontario*, Lat. 45°28′N, Long. 77°32′W

This is another part of the Canadian Shield with large areas covered by glacial sands and gravels. *Listera auriculata* occurs in the latter. The site is in a dense cedar wood with some admixture of hemlock and alders, and is very wet. The forest floor is covered with *Sphagnum* and has a small, much-divided permanent stream flowing through it. The orchids grow in the wet moss and are scattered over a small area never far from the water. Fifteen plants were counted, all in flower on 7 July, 1968.

A voucher specimen has been deposited in the National Herbarium of Canada, Ottawa (CAN).

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Accepted November 10, 1968

Greenland Wheatears Observed at Esker, Labrador, May 20 - June 2, 1967

FOR SOME time Arthur Sorensen and I had been planning a trip to Labrador. Our original plan was to leave Plattsburgh, N.Y., early in the spring before the flies became bad. On May 30 in a snow storm we boarded the Quebec North Shore and Labrador train at Sept-Isles for Esker. Arthur's sister Helen completed the party. Our plan had been to canoe from Lake Astray to Churchill Falls, but when we arrived at Sept-Isles, we learned that the interior lakes were still icebound. A road had been built from Esker to the Falls so Esker became our destination by chance. Our canoe trip became a hike.

> The gazetteer gives the following description of Esker: Esker: interior Labrador, a station of Q., N.S., and L. Railway. 53°45′ N.

When we arrived at Esker, we found that we did not have the proper papers authorizing us to use the road, so we decided to hike to Lake Menihek and establish a camp from which we could make observations on birds and other life.

One of the first birds observed was a new one to us all, a Greenland Wheatear, *Oenanthe oenanthe*. It perched about 12 feet from the ground in a black spruce and appeared to watch us intently. The perch apparently was a favorite, and we came to expect to find it there. It seemed to be as interested in us as we were in it.

As we explored the area around our camp we saw 3 others and as the days went by we knew that we would find each in its perch. Unfortunately we could not remain long enough to learn if they planned to nest in their areas.

The first wheatear that we saw seemed to take an intense interest in us and vied with a Myrtle Warbler, *Dendroica coronata*, for attention from us. The moment we arrived in camp first the one and then the other came, the second coming a little closer than the first, which then came closer. This action kept up until they were 6 to 10 feet from us. It must have been as interesting an experience for them as it was for us.

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Accepted April 26, 1968

Specimen of Gyrfalcon from Southwestern British Columbia

On 15 November 1965 a Gyrfalcon (*Falco rusticolus*) was inadvertantly shot at Burnaby Lake, 10 miles east of Vancouver, British Columbia. It had frequented the marshes of the lake since 12 November, killing and eating domesticated Mallards before it was shot. The Gyrfalcon was skinned and the carcass discarded before the writers could determine sex and weight. The skin was donated to the Ken P. Morrison collection.

The bluish-gray beak and tarsus, the streaked breast (the dark stripes narrower than the white interspaces) and the white-feather edging on the back indicated that it was an immature bird.

Several standard measurements were taken: culmen (from cere), 24.1 mm; tarsus, 65.0 mm; wing (total), 521 mm; tail, 225 mm; and body length, 633 mm. Godfrey (Birds of Canada, National Museum of Canada Bulletin Number 203) describes two subspecies for British Columbia (*uralensis* and *obsoletus*) determined by the length of the fourth primary (number seven) from the outside. Primary feather measurements, from number ten to seven are as follows: 265 mm, 292 mm, 295 mm and 282 mm. The fact that primary seven is longer than (or equal to) the outer feather indicates this specimen is likely *F. r. uralensis*.

Munro and Cowan (A Review of the Bird Fauna of British Columbia, B.C. Provincial Museum Special Publication 2, 1947) list the Gyrfalcon as a scarce winter visitant to British Columbia. This bird is considered as accidental in the 1962 Edition of the Vancouver Checklist.

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Observations on a Partial Albino Great Horned Owl

According to Ross (Cassinia, 2-21, 1963) albinism is extremely rare among owls. In his survey of albinism in North American birds he sites only one record of albinism in the Great Horned Owl (*Bubo virginianus*) making the following observations of special interest.

On 29 Decmeber 1965, I flushed a piebald Great Horned Owl from an eastern hemlock (*Tsuga canadensis*) along the Humber River in Toronto, Ontario. The bird landed in a nearby dead white elm (*Ulmus americanus*) and sat there quietly for a time providing an excellent opportunity for observation. It was strikingly mottled with large areas of white on the wings, back and head. The tail and breast were predominantly brown with only small asymmetrical patches of white. The feathers of the loral region, usually light coloured, were very dark. The bill was remarkably light and the bird's irises were yellow. In flight its wings formed a mosiac of white and brown.

This easily identifiable owl was noted on numerous occasions throughout 1966 and the first half of 1967. In the spring of 1967 it mated with a normally coloured Great Horned Owl and was frequently observed on the resulting nest up to 23 April. A single typically plumaged young was raised.

During the remaining part of 1967 coverage of the area in which the owl had been observed was very poor and the bird was not recorded again until March 1968 when it was found nesting within 25 yards of its 1967 nest site. At this time a great deal of local public attention was focused on the bird and the nesting attempt failed. The observations at the nests in both years suggested that the piebald bird was a female. From a comparison of notes made in 1965 and photographs of the bird taken in 1967 and 1968 it was apparent that very little

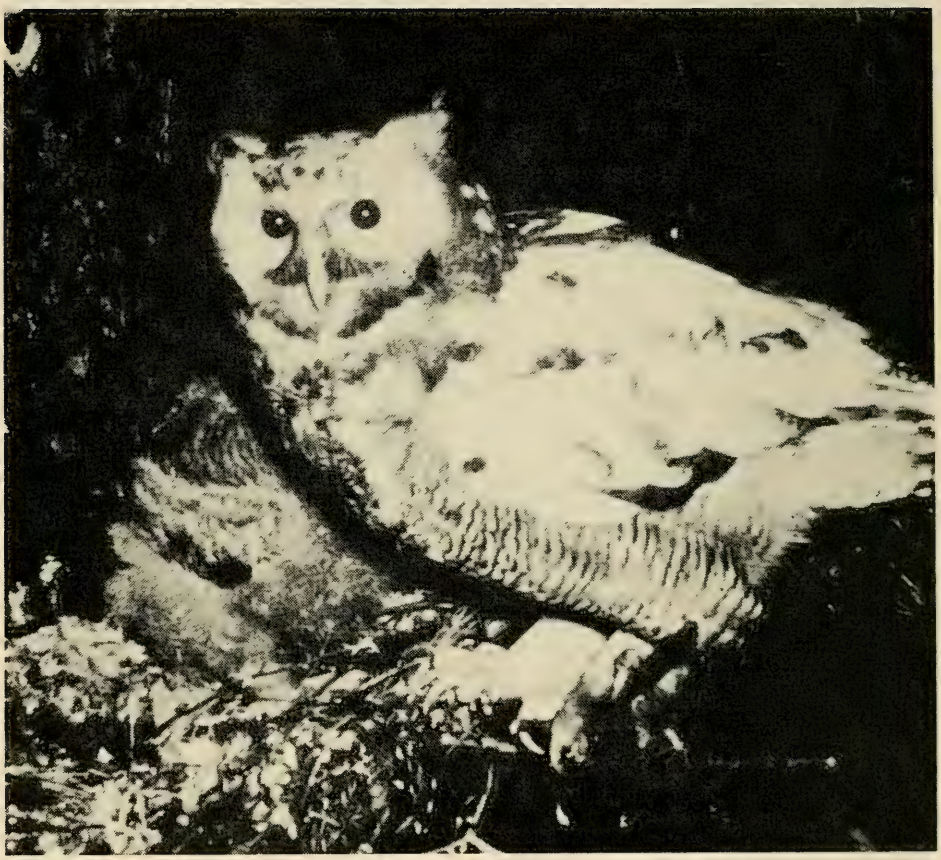

FIGURE 1. Partial albino Great Horned Owl at its 1967 nest. Photograph is a black and white reproduction of a 35 mm colour slide by Messrs. Carmichael, Crich, and James.

change had taken place in the bird's appearance in two and one-third years. To my knowledge the owl was never observed more than a mile from its original position throughout this period.

I should like to thank Dr. Jon C. Barlow of the Department of Ornithology, Royal Ontario Museum, and Mr. M. B. Fenton of the University of Toronto for their help and advice in the preparation of this note. To Messrs. Ken Carmichael, Vic Crich, and Gord James, I would like to extend my thanks for allowing me to use the accompanying photograph of the owl.

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Further Data on Interspecific Competition at a Joint Bufflehead-Goldeneye Nest Site

IN AN earlier note, Erskine (CANADIAN FIELD-NATURALIST 73:131 1959) reported the discovery near Riske Creek, British Columbia, of a nest-cavity in a senile aspen containing a joint clutch of fifteen eggs of Barrow's Goldeneye *Bucephala islandica* and two eggs of Bufflehead *Bucephala albeola*. On June 11, 1958, about half of the Goldeneye eggs were pipping as was one of the Bufflehead eggs. In addition, the nest contained the desiccated corpses of two adult female Bufflehead, estimated to have been dead for one and two years respectively. Four days later, on June 15, J. Hatter and L. G. Sugden of the British Columbia Fish and Wildlife Branch found that all the Goldeneye eggs and one of the Bufflehead eggs had hatched and they were able to account for all the young.

On June 9, 1959, Erskine and McLaren visited the nest and trapped the same female Goldeneye which had been banded there in 1958. The nest contained ten Goldeneye eggs and the corpse of another female Bufflehead, estimated to have been dead about one month (Erskine, CANADIAN FIELD-NATURALIST 74:161-162 1960).

On June 8, 1960, Miss M. F. Jackson, of the Department of Zoology, University of British Columbia, again visited the site and found the same female Goldeneye incubating ten eggs (M. F. Jackson, *pers. comm.*).

Further checking by Sugden and Erskine showed that the same female Goldeneye used the site in 1961 and 1962 without further evidence of interaction with Bufflehead, and a check in 1964 showed the site to be unused (Erskine, *in litt.*).

The site was re-located by McLaren on July 21, 1968, when another dead female Bufflehead was found in the cavity, together with shell fragments and dried membranes of Goldeneye eggs. The Bufflehead appeared to have been dead at least one year and it was not possible to ascertain with certainty whether the egg fragments indicated use of the nest by a Goldeneye during the current year (1968) or the previous year (1967). There were two Goldeneye broods of six and three young respectively on the adjacent slough.

The nest tree, which was described as "senile" in 1958, was dead in 1968. It had broken immediately above the nest entrance hole and the broken top was leaning from the stub forming an angle of about 45 degrees with the flight-line away from the entrance.

In 1958, the tree was recorded as standing twelve feet from the shoreline of the adjacent slough. In 1968 the base of the tree was exactly at the water's edge. This increase in water level has been general throughout the region, according to records kept by the British Columbia Fish and Wildlife Branch (H. B. Mitchell,

pers. comm.), and may well have been the proximal factor causing the death of the tree.

In the same general area, a joint clutch was incubated in 1959 by a female Bufflehead, with partial success in hatching eggs of both species. All other known joint clutches of these two species have been found in Alberta (Erskine, 1960).

The known history of this particular nest-site now extends over a minimum period of ten years, during which the same female Goldeneye nested for at least five successive years (1958-1962), including the hatching of the joint clutch. It is almost certain that she killed the single Bufflehead found in the nest in 1959, and probable that, in different years, she killed the two found in the nest in 1958. Thus, over a ten-year period, at least four female Bufflehead have been killed, possibly by two different Goldeneye females, as a result of attempts to nest in this site, and another Bufflehead was presumably successful in laying two eggs in 1958 without being killed. It is unfortunate that the 1968 occupant of the nest, if any, was not captured, but the nest will be visited during the 1969 field season.

If the concept of competition is to be useful, it must be separated from other forms of ecological interaction under a limited definition involving simultaneous demand and shortness of supply of the environmental resource concerned, as pointed out by Milne (Symp. Soc. Exp. Biol. TV:40-61 1961), among others.

The data noted here from this and other nest-sites in the same region would seem to favour the existence of such a situation in the study area. McLaren (M.Sc. thesis, Dept. of Zoology, University of British Columbia, 1963) was able to show that in this general region the species using cavities excavated by Flickers *Colaptes* showed considerable overlap in the physical characteristics of nest sites and suggested that, particularly since the invasion of the area by the European Starling *Sturna vulgaris*, nest-site competition among species in this ecological grouping was definitely indicated. This conclusion was further supported by numerous instances of egg-foisting, nest destruction and actual fighting between pairs of different species over certain nest-sites.

The present data suggest vigorous "competition" for the use of this particular site, but it should be borne in mind that the site may for some reason be a particularly attractive one. The specific factors which render it so remain obscure: it has been suggested (Erskine, 1960, *op. cit.*) that the ready acceptance by Goldeneyes of nest boxes in this area indicates a shortage of suitable natural nest sites such as this one, but Buffleheads normally nest in old cavities excavated by Flickers, which are relatively abundant in the study area. In 1968, a Bufflehead nest in such a site was found only 30 feet from the joint site, and in previous years Buffleheads have nested in various sites within a distance of 50 metres.

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Notes on the Food Requirements of the Snowy Owl

CRAIGHEAD and Craighead (1956) have shown that information on raptor daily food requirements is necessary for estimating the number of prey individuals required to maintain the predator. Therefore, information on the daily food intake of a juvenile, male Snowy Owl (*Nyctea scandiaca*) was collected during a winter and summer period.

The owl was trapped near Charlo, Lake County in the Flathead Valley of western

TABLE 1. — Food requirements of a juvenile, male snowy owl

No. of days fed	Av. body wt. (grams)	Change in body wt. (grams)	Daily food consumption (grams)		% av. body wt. eaten per day
			Mean	Range	
56	1518	0	131	0–200	8.6
28	1445	226+	145	0–298	10.0

Montana in late November, 1966. He was equipped with jesses, swivel, and leash, and placd on a perch in the University of Montana Research Mews. The owl was "manned", but I was never able to train him to fly to the gloved hand on command. Exercise was obtained by "bating off" the perch (beating the wings continually). He was fed once a day on raw beef heart occasionally supplemented with mice to provide necessary roughage and minerals.

Data on food consumption were collected during two periods: a 56-day period in January and February, and a 28-day period in July, 1967. During feeding trials, the bird was weighed once every 4 days. In the winter period, the weight of the owl was held constant at its capture weight (1518 g) by regulating the daily food ration. At the time of capture, the owl was in good flesh as he had been capitalizing on the high populations of *Microtus* present in the Flathead Valley that fall. In July, the food consumption of the owl was recorded during a 28-day period while he regained his capture weight from an initial weight of 1292 g. During the second period, the owl was offered all the food it would eat in a 30-minute period each day. During both feeding trials, the owl would fast for one or two days at a time while food was available.

Figures on the food consumption of male Snowy Owls vary from 11 to 19% food consumed per day expressed as a per cent of body weight (studies summarized by Watson, 1957). Generally, the female has been reported to consume less than the male (9-11%). The 8.6% and 10.0% recorded for my owl (Table 1) are less than the figures on food consumption by male Snowy Owls reported by others. Considering the mild climate, little exercise, and small amount of indigestible matter given in the diet, 8.6% of the body weight in food eaten per day probably represents the minimum food requirement of male Snowy Owls. It is interesting to note that the food requirements of two other large owls, the Great Horned Owl (*Bubo virginianus*) and the Great Grey Owl (*Strix nebulosa*), are 7.0% and 7.4% of their body weight consumed in food per day (Craighead and Craighead, *op. cit.*).

I wish to thank Dr. W. L. Jellison for donating the owl, and Dr. R. S. Hoffmann for reviewing the manuscript.

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Arctic Fox Attacks on Molting Canada Geese

At 20:25, 18 July 1968, I watched from a distance of 100 yards an Arctic Fox (*Alopex lagopus*) attack and kill a molting adult female Canada Goose (*Branta canadensis*) on a peninsula in the Thelon River, N.W.T. (64°37'N, 100°10'W). The fox, which was seen from a canoe, ran down a hillside and attacked the lone goose 130 yards from shore. The fox, making no sound, repeatedly circled the goose, charging and retreating but always remaining one to three feet from it. The goose defended itself by keeping its head high, neck arched, wings outstretched and turning to face the fox at all times. It charged the fox six times during the 15 minute ordeal. The goose did not attempt to reach the safety of the water even though the fox did not appear to prevent this from happening. Eventually the fox killed the goose by breaking its neck and ate the bird's head before leaving.

J. P. Ryder (pers. comm.) observed an Arctic Fox attack a flock of 60 molting adult geese and 24 flightless juvenile Canada Geese on 31 July 1966 on the Pitok River, N.W.T. (67°40' N, 101°15' W). The fox ran over a hill and attacked the young geese only. It broke the necks of four young geese before they could reach the shore several yards away. At the approach of the canoe the fox ran away.

The distribution of many arctic nesting birds is related to their adaptation to Arctic Fox predation (Larson, 1960. *Oikos*, 11:276-305).Snow Geese (*Chen caerulescens*) and Ross' Geese (*Chen rossii*) nest primarily on islands in the central Arctic, an adaptation that limits Arctic Fox predation (Ryder, *Auk*, in press). During the molting period, geese range over wide areas of the tundra and are particularly susceptible to predation. Observations of Arctic Fox predation on arctic nesting birds are rare in inland areas where lemmings constitute the major food item of foxes during the year (Larson, *op. cit.*).

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A Scissor-tailed Flycatcher in British Columbia

On September 23, 1968, at approximately 11.30 A.M., Mr. Ron Walker of Cascade, British Columbia, called at my house in Grand Forks, B.C., and informed me that he had seen a Scissor-tailed Flycatcher *Muscivora forficata* beside the highway about three miles east of Grand Forks. My wife and I followed Mr. and Mrs. Walker in our car to the spot where they had first seen the flycatcher, and found that it was still in the vicinity.

The flycatcher was alone, but Mr. Walker had previously seen it in proximity to several Audubon Warbler's, *Dendroica auduboni*. The four of us kept the flycatcher under close observation for fifteen or twenty minutes, the bird showing no apparent concern at our presence or that of the two parked cars. During the time we had the bird under observation it flew around and above us, thereby affording an opportunity to note the spreading and closing of the long, strangely marked tail, as the bird perched occasionally on a fence wire beside the road, or on the top of some small bushes, and once on the tip of a mullein plant, *Verbascum thapsis*, about fifty feet from where we were standing. The flycatcher was not seen to take any food, but there may be some significance in the fact that grasshoppers were very numerous and active in the locality where this flycatcher was observed. Finally, the bird flew off in a southerly direction and disappeared.

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NEWS AND COMMENT

The Nature Preserves Act of the State of Indiana (Act No. 176)

For anyone contemplating the formulation of legislation to preserve Natural and Scientific Areas, the content and wording of this act will be very useful. This law (1) provides the establishment of a registry of areas possessing features of unique natural significance, (2) establishes a procedure for the dedication of such areas as Nature Preserves, (3) declares the areas so dedicated are put to their highest and best public use, (4) provides that the Articles of Dedication may set forth any number of patterns of use and ownership and (5) establishes a procedure for the amending of the Articles of Dedication based upon a specific finding of an unavoidable alternative public need by the Indiana Natural Resources Commission.

The full text of the Act is also reprinted in the quarterly magazine *Trends in Parks and Recreation*, Volume 5, Number 1, (1968), a publication of the Park Practice Program, issued by the United States Department of the Interior, National Park Service, Washington.

Editor

Federal Government Preserves Waterfowl Breeding Area

Purchase by the federal government of Iles-de-la-Paix, 14 low-lying islands covering about 300 acres near the south shore of Lake St. Louis, 20 miles southwest of Montreal, was announced by the Honourable Jean Chrétien, Minister of Indian Affairs and Northern Development.

The government bought the islands – most of them owned by the Grey Nuns of Montreal – for about $35,000, in order to preserve some of the fast-disappearing habitat for ducks and other migratory water birds in the Montreal area. The first acquisition made in the Province of Quebec under the national program for preserving habitat for migratory waterfowl, it was carried out with the co-operation of the Quebec Department of Tourism, Fish and Game.

It is one of the aims of the National Wildlife Policy and Program to take such action, wherever it is badly needed throughout Canada. Losses of waterfowl habitat have been particularly severe in the Montreal area in the last few years. Iles-de-la-Paix were selected for purchase after studies carried out by wildlife biologists showed that they provided good habitat for at least seven species of waterfowl nesting there. In addition, they discovered a great variety of non-game birds on the islands.

"By taking this action we will ensure that these birds will still have a place to live, where they can contribute to the pleasures of hunters and naturalists and to those who simply enjoy the outdoors. Picnicking, swimming, hunting and other outdoor activities allowed by the previous owners will be permitted to continue in designated areas," said Mr. Chrétien, "so long as these activities do not conflict with the main purpose of protecting wildlife on the islands. Camping and the construction of summer cottages will not be allowed."

The Canadian Wildlife Service will conduct research on waterfowl and will carry out a management program designed to increase the value of the habitat for migratory birds. The islands may also be used for ecological research by universities.

One of the first undertakings of the wetlands preservation program was the leasing of prairie potholes. A few areas have been purchased in the Maritimes and the government intends to obtain control of areas elsewhere, either by purchase, lease, or other forms of agreement in order to ensure the continued availability of habitat required by migratory birds.

Department of Indian Affairs and Northern Development
Ottawa

LETTERS

Jurisdiction Over Raptorial Birds

While there has been an encouraging positive change in public attitude toward the birds of prey in North America in the last 20 years, there are signs that all is not well. There is evidence that, in addition to the general pesticide threat, indiscriminate shooting goes on with little attempt at prosecution, and that nests are frequently disturbed or robbed. Legal and illegal trafficking, particularly in the rarer species, is increasing, as is the amount of money being exchanged in such transactions. The combined demands of falconry, captive breeding attempts, zoos, touring displays and mascot programs are now reaching considerable proportions.

A difficulty in conservation and management of raptors in the face of such threats is that protective legislation and destructive threats vary greatly from State to State and Province to Province, while most species of concern are highly migratory. Thus no one political unit feels any great responsibility toward maintenance of continental populations. There is little to be gained by protecting nesting birds in the north if they are subsequently trapped during migration or shot on their wintering grounds. Likewise, strict protection in winter habitats is of little use if nests are robbed in the north. Some States and Provinces allow legal harvests, even of the rarer species, while others do not. Similar inconsistencies apply to export of birds.

A partial answer to this dilemma might consist of inclusion of flaconiform birds under the Migratory Bird Convention Act. While this would not directly ameliorate the pesticide threat, or protect the many birds which migrate to South America, it would at least result in consistent policy within the member countries, and thus better insure the long term survival of such species as the peregerine and prairie falcons. Violation of ensuing regulations would then become a Federal offence, this in itself being a good deterrent. More fedrally sponsored research into raptor-pesticide relationships could also be a result.

I think that most people concerned about the raptors would be in favor of Federal jurisdiction over them. Perhaps this letter will stimulate some action in that direction.

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A Plea for Federal Protection of the Peregrine Falcon

Volume 82, Number 3, of the Canadian Field-Naturalist featured a paper by Donald A. Blood, titled: "Population Status of Peregrine Falcons in the Queen Charlotte Islands, British Columbia" (Blood, 1968). On page 174, under the heading "Nestling Harvest", Blood conludes: "The cumulative removal to date (of nestlings by falconers) appears to have had no adverse effect on the population status of peregrines (*Falco peregrinus*) in the Queen Charlotte Islands." Contradictory to this is another statement at the bottom of the same page under the heading "Summary": "There is evidence that the number of active eyries has declined significantly in at least one area where former breeding densities were very high". This latter area, Langara Island, was the subject of an earlier study by Beebe (1960), whose paper, published in the Condor, included a map on which exact locations of the eyries was indicated. As a result of that paper an unspecified number of falconers, many from the U.S., went to Langara and competed with

each other in raiding the falcon eyries. Of 12 Peregrine nests that Beebe found on the island only 4 were occupied in 1966 (7 minus 3 that were found by Blood, but not by Beebe). This constitutes a decline of 66% in an area where it is known that falconers have been active since 1952 *and which is relatively free of pesticides.* (Hancock, 1969). Pesticide contamination has been blamed for the extirpation of many Peregrine populations. Apart from the facts concerning Langara Island, there are other indications that human disturbance may have played a more important role than is generally realized. Cade et al. (1967) and Enderson and Berger (1968), in racent studies on the Yukon and Mackenzie Rivers, disclosed that the number of Peregrine eyries and their reproductive success appeared normal, *in spite of heavy contamination by pesticide residues.* Eggs taken by Enderson contained about twice as much Chlorinated Hydrocarbon residues as in stricken English populations. On the other hand, the North American Peregrine populations, that have virtually disappeared were not situated in wilderness areas but in settled regions and were subject to various forms of persecution by humans, as documented by Herbert (1965) and Dekker (1967). Peregrine populations in Northern Europe appear to be effected more thoroughly. Finnish birds are badly diminished in spite of relative freedom from human interference at their wilderness nesting sites. But the dangers to these birds, once they migrate, appear far greater than is the case in Western North America. On some of their migratory routes and wintering grounds, such as the Dutch lowlands, pesticides were used in concentrations which *directly* resulted in the crippling and dying of tens of thousands of potential prey species of the Peregrine. The (easy) capture of one or three of these birds may well have resulted in quick doom to a raptor. According to Voous (1965), in two months time in the spring of 1960 27,000 dead birds were picked up in the Netherlands, of which 159 were hawks and owls. It is estimated that about 10 times that many birds were killed as a result of the distribution of seeds treated with Partahion expressly to kill harmful birds and rodents. Added to such disasters is the constant threat to raptors by bird catchers and hunters of all kinds in Belgium, France, Italy, Spain and Portugal, where the catching of passerines for food and as pets is a favourite pastime. Hawks are attracted to the lure birds and are caught in the nets. In France alone, an estimated 200,000 raptors are killed yearly (Voous, 1965).

To the plight of European Peregrines falconers have responded in a singularly nationalistic way. For instance, German falconers decided to leave the remnants of the native population alone, and turned their attention to Southern and Eastern Europe, as well as North America. In Italy alone 60 young Peregrines were known to be robbed by German falconers in 1968. (Raptor Research News 2(4): 74). The large falcons, Lanners (*Falco biarmicus*) and Sakers (*Falco cherrug*) as well as Peregrines are taken from nests in Italy, Spain and Hungary in such numbers, year after year, that Fischer (1967) states that for that reason alone entire populations are bound to die out. Fischer, as well as the writer of his manuscript, have had the privilege of meeting some of the best falconers in Europe. These people are very dedicated and skilful. They have a great knowledge of raptors. Birds in their possession are treated with infinite patience and care. It is a very difficult business to train and fly a hawk properly. Unfortunately, the bulk of so-called falconers lack time and skill to keep their birds in good flying condition. They are no more than glorified keepers of ego-boosting pets. As a whole, falconers might be classified as consumptive users of a natural resources. If they are allowed to take their share of the falcons, what valid reason is there to exclude other consumptive users such as amateur collectors and taxidermists?

Privately, responsible falconers agree that the Peregrine should be left alone. They would settle for other species of raptor. But the large falcons bring a high price to unscrupulous individuals in many parts of the world. There will always be a certain amount of illegal catching and selling. But this is a poor argument for trying to keep certain areas open for the collection of Peregrines. Northern Canada still harbours a good population of Peregrines. But as Cade (1967) and Enderson (1968) have pointed out, due to high ratios of pesticide residues, these birds may be poised at the brink of disaster. Human disturbance at the nest sites, by researchers as well as falconers, should be kept at a minimum. At preent, Alaska, the Yukon and the N.W.T. are closed to the taking of young Peregrines. This protection should be extended to other areas, such as the Queen Charlotte Islands. Blood's recent paper comes at a critical time. His conclusion that the taking of young falcons has had no adverse effect on the population status of the Peregrine, is debatable and contrary to other reports (Hancock, 1969). In correspondence with the writer of this manuscript Blood admits that the desertion of nests at Langara may quite possibly be the result of human interference, both legal and illegal, but because this desertion took place before he started his research, he did not care to speculate on the cause since there was little to go on. As his paper reads now, there is a danger that it will be used by certain individuals in their attempts to get a larger share of what they like to call the "harvest" of young Peregrines for falconry purposes.

In general, it is plain that the status of the Peregrine in the Western Hemisphere shows a dangerous trend toward total extirpation. Federal, continent-wide, protection will no doubt be extended to this magnificent bird once its numbers will have reached the same order of magnitude as that of the Whooping Crane (*Grus americana*). But then it may well be too late. The time to protect the Peregrine effectivly, is *now*, when it is still common in part of its former world-wide range.

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The Need for a Truly Representative National Organization for Canadian Naturalists

Organizationally, the Naturalists' Movement in Canada is not nearly as influential as it could be. The reason is not so much a lack of interest in animals and plants on the part of Canadians generally, as it is due to regionally and locally oriented societies as well as a shortage of leaders concerned with a *national* approach to Canadian natural history and conservation problems. Indeed, at present, the phrase the "Naturalists' Movement" is really only an abstraction based upon a recognition that naturalists' clubs and societies across the country *do* have many interests and aspirations in common. They also face similar problems on which unified action would be far more effective than would independent action.

In more than one province (e.g. in B.C., Saskatchewan, Manitoba, Ontario and Newfoundland) there is a federation of all naturalists' clubs or a province-wide naturalists' society, and in these provinces the Naturalists' Movement is manifestly much stronger than elsewhere. Yet, in the nation as a whole, the Naturalists' Movement remains weak. There is no national conference where problems of mutual interest can be discussed by delegates from the executive councils of all the provincial societies or federations.

In Canada there are upwards of two million Canadians who hunt or fish. The provincial federations of fish and game clubs are served at the national level by the Canadian Wildlife Federation, which represents 160,000 of these hunters and fishermen. A recent estimate has suggested that Canadians with interests in natural history number at least one million, although a much smaller proportion are active in any naturalists' society. The only national organization that can currently claim to speak for Canadian naturalists as a whole is the Canadian Audubon Society. But the Canadian Audubon Society does not have a strong individual membership base and, more important, the regional naturalists' organizations are not directly represented on its Board of Directors. Instead it claims an undisclosed number of "affiliates", from among which several of the larger naturalists' societies and provincial federations are missing. In the past, the affiliates have played little or no part in determining C.A.S. policies, and the annual meeting of the C.A.S. has seldom, if ever, been held outside Ontario.

It is reasonable to conclude, therefore, that the Naturalists' Movement in Canada would be enormously strengthened and better served if there were a "Canadian Union of Naturalists' Organizations" ("*C.U.N.O.*") which would be governed by a Board of Directors elected by the provincial naturalists' federations or societies. "*C.U.N.O.*" would have, as its primary purposes, the provision of advice and assistance to local groups when needed, the provision of coordinated conservation guidelines for all naturalists' groups, and the taking of direct action itself on their behalf whenever this were deemed necessary on a matter of more than provincial concern. But, because of its intimate link with all provincial naturalists' groups, "*C.U.N.O.*" would hopefully also quickly become the main distributor across the country of news and information of interest to all naturalists. It would probably publish a news-sheet, which could be distributed (free to all M.P.'s, M.L.A.'s, and news media, and (for a small subscription) to interested members of the general public. Kingfisher, published in England is an example of the form it might take – brief news capsules which cite the publication or organization from which they are derived, so that more detail can be obtained by anyone interested in a particular item.

To this point, "*C.U.N.O.*" would appear to be filling a vacuum in the Canadian scene, not already filled by the Canadian Audubon Society. Though, in its function, it would resemble the Canadian Wildlife Federation, the groups of which it would be composed and to which it would be responsible would be quite different. Nevertheless, the question arises whether it would not be better for the proposed "*C.U.N.O.*" and the Canadian Audubon Society to be one and the same organization. If the C.A.S. were to change its name and organization so that it became, in fact, a National Union of Naturalists' Organizations, its effectiveness as a conservation organization would be much enhanced.

In addition to a widely-distributed information news-sheet, which such a national organization might publish, it might also assume responsibility for the publication of CANADIAN AUDUBON for the general reader, and negotiate for the publication of the CANADIAN FIELD-NATURALIST under the "*C.U.N.O.*" imprint. The result would be the establishment of a *single* national naturalists' organization *representative of all the naturalists' groups in Canada* with the provincial federations supporting it. For many Canadians the formation of a *truly national* naturalists' organization would mean a welcome increase in co-operation and communication among naturalists.

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REVIEWS

The Lovely and the Wild

By Louise de Kiriline Lawrence. McGraw-Hill Book Co., New York, Toronto, London, Sydney. 228 pp. 1968. $8.75.

No one who reads this book will ever observe birds or other wild creatures in quite the same way again. The title suggests a delight in wildness, which permeates the pages, but it fails to indicate the book's contribution to the study of bird behaviour. Its wealth of original observations, detailed with profound regard for accuracy, will interest both experienced observer and beginner. The author writes skilfully and with warmth and charm, to bring us, for instance, her discovery of the mysterious flight song of the ovenbird, or the strange antics of a pair of nesting redstarts, or the cruel hazards facing a wild animal transported out of familiar territory.

A native of Sweden, Louise de Kiriline Lawrence was unfamiliar with North American birds when she settled in her wilderness home west of Mattawa, Ontario. But years of the most intensive study resulted in an amazing knowledge of the birds of the wilderness that surrounded her. She began modestly by identfying one species after another to add to her bird list. But list-making was too superficial an approach for this remarkable woman, and she soon graduated to be what she calls a watcher, her greatest rewards coming with insight into the meaning of bird behaviour. Her faculty to interpret bird behaviour will hold the seasoned observer enthralled. The author has a talent for grasping the survival value of seemingly meaningless instinctive behaviour, and for comprehending unsuspected mechanisms by which wild nature, unaided by man, remains in a state of natural balance. An unusual perspective is gained as each creature is studied, not as an isolated entity, but always as an integral part of the life of the forest.

A thrilling description of a wilderness paddle up the Mattawa thirty years ago, with bird song echoing wildly from ravine after ravine, concludes with a simple statement. "All this was long ago. It is no longer the same." There are unexplained empty spaces in the wilderness today, "marvellous woodland habitats now unoccupied and silent after migration". This contention is documented by carefully recorded data, daily counts and seasonal censuses taken over a period of many years in virtually unchanged habitat in the same area. The author's records show 1949-1950 to mark the beginning of a drastic decline in the numbers of nearly all species of woodland songbirds, a decline which, tragically, has continued for at least fifteen years. It would appear that, in ways not fully understood, man has at last interfered with wild nature so seriously that he is beginning to destroy the achievements of the ages. This alarming disclosure is presented simply and factually, with a plea for an awareness of what is happening, and for safeguards against heedless devastation.

The book is charmingly illustrated with black and white sketches by Glen Loates.

Sheila Thomson

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Hours and the Birds

By R. D. Symons. 1967. University of Toronto Press, Toronto. 224 pp., 17 colour plates, numerous drawings. $12.50.

Almost anyone who likes to read about wild birds, especially if he knows Saskatchewan, will greatly enjoy this different and attractive book. The author has lived over fifty years in Saskatchewan and other parts of the Canadian West, at times as a rancher, wheat farmer, homesteader, and teacher, but always an enthusiastic naturalist.

The book is an absorbing account of his many experiences and impressions of outdoors Saskatchewan, especially its birds. Symons knows Saskatchewan intimately and his genuine affection for it shows on every page. His style is direct, clear, often vivid, occasionally curt. He writes of the birds as he sees them and he does this with many a subtle touch that a less sensitive observer would miss completely.

The general reader will learn much about Saskatchewan birds and the experienced bird watcher will enjoy seeing the birds again from Symon's viewpoint. Indeed, there is a considerable amount of information in the book that will interest the professional. For instance, cases are described and illustrated in color of the Bonaparte Gull nesting on the ground instead of in the tree nests of other birds. We learn that many of the Ruffed Grouse used to stock the Cypress Hills came from the Battleford area. There are numerous distributional data scattered through the text.

Many drawings and 17 color plates, all the work of the author, handsomely illustrate the book. The field sketches were done at different times over the years and often under trying conditions. As is to be expected under such circumstances, the quality is somewhat variable but the pictures are not less interesting for that. Most are really delightful.

The 'young' Starling (p. 94), however, looks more like a spotted winter adult; the 'young' Cedar Waxwings (p. 170) show no breast streaks; and the presence of the male hummingbird at the nest is likely to convey to readers the erroneous impression that he takes part in the nesting activities. Words like caterpillar, scavenging, shelter, and aggressive are mispelled in the captions of the illustrations (the last four times!), although these words are spelled correctly in the text. It is our Winter Wren, not our House Wren, that occurs in England (p. 4).

The book closes with some good advice on looking for birds, a check-list of the birds of Saskatchewan, a selected bibliography, and an index.

As he nears the end of the book, the author tells us, "Look for beauty and you will find it, remembering that the eye sees only as the heart desires". Obviously that philosophy has long been one of the author's powerful motivations, for beauty is certainly one of the main ingredients of this unusual and charming book.

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A Lifetime with the Birds: An Ornithological Logbook

By EARLE R. GREENE. 1966. Edwards Brothers, Ann Arbor. 404 pp., 110 halftones. $6.00. (Obtainable from E. R. Greene, 1600 West Fifth St., Oxnard, California 93030).

This is an autobiographical account of over sixty years of association with North America's birds and bird watchers. Earle Greene has travelled widely over this continent and in his travels he has identified well over 600 species of birds. He has a great interest in people as well as in birds. He knows most of this continent's ornithologists, both old and young, and as a result the names of bird men and women are mentioned fully as frequently as are those of birds.

The book is abundantly illustrated with photographs of people and places of particular interest to bird students. Anyone who has ever attended a large convention of North American ornithologists will find familiar names of both men and birds in this interesting book as well as familiar faces and places in the photographs liberally scattered through the text.

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Trees

By ANDREAS FEININGER. The Viking Press, New York and the Macmillan Co. of Canada, Toronto. 1968. 160 illus., 116 pp. $23.75.

In this volume Mr. Feininger presents a series of absolutely beautiful full-page photographs, one quarter of which are in colour, which have been selected from over 5000 photographs taken in his travels throughout the United States and around the world. He has seen beauty in the stately thousand-year-old sequoias, twisted roots, the dead branches of a bristle pine, the annual rings, the bark of a birch tree, a spray of leaves silhouetted against the sky, and many other facets related to trees, which might to the casual observer go unnoticed.

There is an introduction and a chapter on the importance of trees. The pictures then illustrate the succeeding chapters which deal among other things with facts about trees, their various parts, great age and size and the fall colours. The text is easily written and authoritative, but will I am afraid be little read because of the beauty of the pictures. For each picture there is an accompanying descriptive paragraph, but because these are divorced from the pictures, they too will be little consulted.

That Mr. Feininger is a conservationist is amply attested to by the love and care he has taken in portraying his subjects. His final chapter entitled "You Can Help" is an appeal to the American people to be concerned with preservation of their national heritage.

As an appendix for the interested photographer there is a record of the type of camera, lens and exposure used for each photograph.

The volume which measures 10¼ by 12½ inches in size was printed in West Germany by F. Bruckmann KG, Munich.

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OTHER NEW TITLES

The following titles are offered as a service to readers. Their listing does not preclude them from possible review in a future issue of this journal.

Cities are People. S. Carl Hirsch. Viking Press, 1968. Photographs. 176 p. $4.95 (US).

A Field Guide to the Mammals of Britain and Europe. F. H. van den Brink, transl. from Dutch and edited by Hans Kruuk and H. N. Southern. Houghton, 1968. Plates, illus. by Paul Barruel, maps. 221 p. $7.50 (US).

Plant Communities. A Textbook of Plant Synecology. Rexford Daubenmire. Harper and Row, New York, 1968. Illus. 300 p. $9.75 (US).

International Zoo Yearbook. Vol. 8. Caroline Jarvis and Ruth Biegler (Eds.). Zoological Society of London, London, 1968. Illus. 414 p. $18.75 (US).

Advances in Water Quality Improvement. Earnest F. Gloyna and W. Wesley Eckenfelder, Jr. (Eds.). Univ. of Texas Press, 1968. Illus. 513 p. $15 (US).

The Book of The Giraffe. C. A. Spinage. Houghton Mifflin, Boston, 1968. Illus. 191 p. $6.95 (US).

Ecological Adaptations for Breeding in Birds. David Lack. Methuen, London, 1968 (distributed in the U.S. by Barnes and Noble, New York). Illus. 409 p. $15 (US).

Encyclopedia of Animal Care. (Formerly Black's Veterinary Directory). William C. Miller and Geoffrey P. West. Williams and Wilkins, Baltimore, ed. 8. 1967. Illus. 1015 p. $10.25 (US).

Environmental Problems. Pesticides, Thermal Pollution, and Environmental Synergisms. Bill Ray Wilson (Ed.). Lippincott, Philadelphia, 1968. Illus. 183 p. $5.25 (US).

Evolution in Changing Environments. Some Theoretical Explorations. Richard Levins. Princeton University Press, Princeton, N.J., 1968. Illus. 120 p. $6.50. Monographs in Population Biology, No. 2.

Heredity, Evolution, and Society. I. Michael Lerner. Freeman, San Francisco, 1968. Illus. 307 p. $8 (US).

Immunity to Parasites. Sixth Symposium of the British Society for Parasitology, London, Nov. 1967. Angela E. R. Taylor (Ed.). Blackwell Scientific Publications, Oxford, 1968. Illus. 118 p. $6.50 (US). Paperback.

The Roe Deer of Cranborne Chase. An Ecological Survey. Richard Prior. With an Appendix on the Diseases of Roe by A. McDiarmid. Oxford University Press, New York, 1968. Illus. 222 p. $7 (US).

The Systems Approach. C. West Churchman. Delacorte, New York, 1968. 243 p. $7.50 (US).

Towards a Better Use of the Oceans. A Study and Prognosis. SIPRI Symposium, Stockholm, June 1968. International Institute for Peace and Conflict Research. Stockholm, 1968. 323 p. $6 (US).

Man and the California Condor: The Embattled History and Uncertain Future of North America's Largest Free-living Bird. Ian McMillan. Dutton, 1968. Illus. 191 p. $5.95 (US).

The Place No One Knew: Glen Canyon on the Colorado. Eliot Porter. Sierra Club Ballantine Bks., 1968. 75 color plates. 160 p. $3.95 (US). Paperback.

Social Organization of the Hamadryas Baboons: A Field Study. Hans Kummer. Univ. of Chicago Press, 1968. Photographs, diagrams. 189 p. $8.95 (US).

Industrial Waste Disposal. R. D. Ross (Ed.). Reinhold, 1968. Illus. 340 p. $16 (US).

Spaceship Earth. Barbara Ward. Columbia Univ. Press, 1968. 152 p, $1.95 (US). Peperback.

The Teacher and the Machine: Horace Mann Lecture 1967. Philip W. Jackson. Univ. of Pittsburgh Press, 1968. 90 p. $2.50 (US).

Unusual Aquarium Fishes. Alan Mark Fletcher. Lippincott, 1968. Photographs. 143 p. $4.50 (US).

Wild Flowers of North Carolina. William S. Justice and C. Ritchie Bell. Univ. of N.C. Press, 1968. 400 color photographs, drawings. 217 p $7.75 (US).

Arctic and Alpine Research. Institute of Arctic and Alpine Research, University of Colorado, Boulder. A new quarterly journal beginning January-March, 1969. $12.00 (US) per year.

Ecological Development in Polar Regions. A Study in Evolution. M. J. Dunbar. Prentice-Hall, Englewood Cliffs, N.J., 1968. Illus. 119 p. $4.95. Concepts of Modern Biology.

Science Policy and the University. Harold Orlans (Ed.), Brookings Institution, 1968. 352 p. $7.50 Cloth; $2.95 (US) Paperback.

Scientists in Politics: The Atomic Scientists Movement, 1945-46. Donald A. Strickland. Purdue Univ. Press, 1968. 149 p. $4.95 (US).

The Fitness of Man's Environment: Smithsonian Annual II. Robert McAdams and others, introd. by Rt. Hon. Jennie Lee. Smithsonian Inst. Press, 1968. 250 p. $5.95. Twelve contributions on the theme that man can no longer afford to alter his environment without recognizing that environment is the dynamic sum of its interrelated parts.

The Rays are not Coloured: Essays on the Science of Vision and Colour. W. D. Wright. Am. Elsevier Pub. Co., 1968. Color plates, diagrams. 154 p. $5.95 (US).

Waterfowl: Their Biology and Natural History. Paul A. Johnsgaard, introd. by Peter Scott. Univ. of Neb. Press, 1968. 148 plates (59 in color), drawings. 138 p. $8.95 (US).

World Population: An Analysis of Vital Data. Nathan Keyfitz and Wilhelm Flieger. Univ. of Chicago Press, 1968. 672 p. $16.50 (US).

Scientific Writing for Graduate Students. F. Peter Woodford (Ed.). A Council of

Biology Editors Manual prepared by the CBE Committee on Graduate Training in Scientific Writing. Rockefeller University Press, New York. 1968. 192 p. $5.95 (US).

Animals for Research: A Directory of Sources of Laboratory Animals, Fluids, Tissues, Organs, Equipment and Materials. Institute of Laboratory Animal Resources, NRC. National Acad. of Sciences, 1968. 7th rev. ed. 125 p. $3.25 (US). Paperback.

Animals in Danger: The Story of Vanishing American Wildlife. Frances and Dorothy Wood Dodd, 1968. Photographs. 181 p. $4.95 (US).

The Biology of the Cockroach. D. M. Guthrie and A. R. Tindall. St. Martin's Press, 1968. Illus. 408 p. $19 (US).

Fish Migration. F. R. Harden Jones. St. Martin's Press, 1968. Illus. by H. E. Jenner. 325 p. $21. (US).

In the Wake of the Sea-Serpents. Bernard Heuvelmans. Trans. from French by Richard Garnett. Hill & Wang, 1968. Illus. 645 p. $10. (US).

Life Histories of North American Cardinals, Grosbeaks, Buntings, Towhees, Finches, Sparrows and Allies, Order Passeriformes: Family Fringillidae. Parts 1-3. Arthur Cleveland Bent and Collaborators, Oliver L. Austin, Jr. (Ed.). Smithsonian Institution, 1968. 80 plates. 1889 p. $8.25 (US) per set of 3 vols. Paperback.

Animal Societies: From the Bee to the Gorilla. Remy Chauvin, transl. from French by George Ordish. Hill & Wang, 1968. 45 plates, drawings. 281 p. $6.50 (US).

Antarctic Bird Studies: Antarctic Research Series, Vol. 12. Oliver L. Austin, Jr. (Ed.). Am. Geophysical Union, 1968. Illus. 262 p. $16.50 (US).

Selective Toxicity and Related Topics. Adrien Albert. Methuen (Barnes & Noble), 1968, 4th edition. Illus. 531 p. Deals with the physical and chemical properties of selectively toxic agents, those substances which injure certain cells without harming others, covering most of the drugs and all of the fungicides, insecticides and weed killers. $14.50 (US).

Telescopes: How to Choose and Use Them. Terry Maloney. Sterling Pub. Co., 1968. Illus. 114 p. Useful advice for the amateur astronomer and birdwatcher. $3.95 (US).

Ecology and Resource Management: A Quantitative Approach. Kenneth E. F. Watt, McGraw Hill, 1968.

The Cycle of Erosion in Different Climates. Pierre Birot, transl. from French by C. Ian Jackson and Keith M. Clayton. Univ. of Calif. Press, 1968. Illus. 144 p. $5.50 (US).

A Handbook of Living Primates: Morphology, Ecology and Behavior of Nonhuman Primates. J. R. Napier and P. H. Napier. Academic Press, 1967. Illus. 456 p. $21.50 (US).

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Australian Tertiary Deposits Containing Terrestrial Mammals. R A. Stirton, R. H. Tedford and M. O. Woodburne. University of California Press, Berkeley, 1968. Illus. 30 p. $1.50 (US). Paperback. Publications in Geological Sciences. Vol. 77.

Endocrinologie des Insectes. Pierre Joly. Mason, Paris, 1968. Illus. 344 p. Collection les Grands Problèmes de la Biologie, Monographie 7. 96F.

The Enzymatic Oxidation of Toxicants. Proceedings of a conference, Raleigh, N.C. Ernest Hodgson (Ed.). North Carolina State University, Raleigh, 1968. Illus. 229 p. $2. (US). Paperback.

Evolution and the Genetics of Populations. A Treatise in Three Volumes. Vol 1, Genetic and Biometric Foundations. Sewall Wright. University of Chicago Press, Chicago, 1968. Illus. 469 p. $15. (US).

The Evolutionary History of the Avian Genus Chrysoccocyx. Herbert Friedmann. Smithsonian Institution Press, Washington,

D.C., 1968. Illus. 137 p. Paperback. U.S. National Museum Bulletin No. 265.

Field Book of Wild Birds and Their Music. F. Schuyler Mathews, Dover, New York. 1967. Illus. 350 p. $2.75 (US). Paperback. Reprint of the 1921 Edition.

An Introduction to Advanced Geography. E. W. H. Briault and J. H. Hubbard. Elsevier, New York, ed. 2, 1968. Illus. 503 p. $7. (US).

The Mountaineering Handbook. An Invitation to Climbing. Curtis W. Casewit and Dick Pownall. Lippincott, Philadelphia. 1968. Illus. 222 p. $5.95 (US).
$5.95 (US).

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Oceans. Karl K. Turekian. Prentice-Hall, Englewood Cliffs, N.J., 1968. Illus. 120 p. Cloth, $5.95; Paperback, $2. (US).

The Origin of the Solar System. H. P. Bérlage. Pergamon, New York, 1968. Illus. 130 p. $1.85 (US). Paperback. Pergamon International Popular Science Series.

The Population Bomb. Paul A. Ehrlich. Ballantine Books. New York, 1968. 224 p. Paperback. 95c. (US). A Sierra Club-Ballantine Book. Very highly recommended as an introduction to a complex problem. For the general reader.

Teaching Children Science. An Inquiry Approach. Louis I. Kuslan and A. Harris Stone. Wadsworth, Belmont, Calif., 1968. Illus. 464 p. $7.95 (US).

Reproduction in the Female Mammal. Proceedings of the 13th Easter School in Agricultural Science, Nottingham, England, 1966. G. E. Lamming and E. C. Amoroso (Eds.). Plenum, New York; Butterworths, London, 1967. Illus. 583 p. $32 (US).

Biology of Gestation. Vol. 1, The Maternal Organism. N. S. Assali (Ed.). Academic Press, New York, 1968. Illus. 507 p. $27. (US).

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A Guide to the National Parks. Their Landscape and Geology. William H. Matthews, III. Natural History Press, Garden City, N.Y., 1968. Vol. 1, The Western Parks. Illus. 480 p. $7.95; Vol. 2, The Eastern Parks. Illus. 287 p. $6.95 (US).

Man and Aggression. M. F. Ashley Montagu (Ed.). Oxford University Press, New York, 1968. 178 p. Cloth, $5; Paperback, $1.95 (US).

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The Physiology of Sense Organs. De-Forest Mellon. Jr. Oliver and Boyd, Edinburgh, 1968. University Reviews in Biology. Illus. 107 p. 25s. Paperback.

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The Conservation of Norfolk Island. J. S. Turner, C. N. Smithers and R. D. Hoogland. Australian Conservation Foundation, Australia, 1968. Illus. 41 p. Paperback. ACF Special Publication No. 1.

Data Acquisition and Processing in Biology and Medicine. Vol. 5. Proceedings of a conference. Rochester, N.Y., 1966. Kurt Enslein (Ed.). Pergamon, New York, 1968. Illus. 377 p. $16 (US).

Index to Air Pollution Research. A guide to Current Government and Industry Supported Air Pollution Research, July 1968. Patricia A. Burd. Center for Air Environment Studies, Pennsylvania State University, University Park, 1968. 164 p. $2. (US). Paperback.

Proceedings of the Fifteenth Southern Water Resources and Pollution Control Conference. Raleigh, N.C., April, 1966. Department of Civil Engineering, North Carolina State University. Raleigh, 1968. Illus. 190 p. $4. (US)). Paperback.

Science and Man. The Philosophy of Scientific Humanism. Tad S. Clements. Thomas, Springfield, Ill., 1968. 152 p. $9. (US). American Lecture Series Publication No. 714.

War and Peace in the Global Village. An Inventory of Some of the Current Spastic Situations that could be Eliminated by more Feed-forward. Marshall McLuhan and Quentin Fiore. McGraw-Hill. New-York, 1968. Illus. 192 p. Cloth, $5.95; Paperback, $1.95 (US).

Air Pollution. R. S. Scorer. Pergamon Press, 1968. Color plates, photographs, diagrams. 151 p. $7.50, Cloth; $4.50 Paperback (US).

The Biology of Estuarine Animals. J. Green. Univ. of Wash. Press, 1968. Illus. 401 p. $9.50 (US).

Central Asia. Aleksandr Belenitsky, transl. from Russian by James Hogarth. World Pub. Co., 1968. 250 p. 54 color plates, 89 photographs. Includes Uzbek, Tadzhik, Turkmenian and Kirghiz Republics and the southern part of the Kazakh Republic. $10. (US).

The Farming of Fish. C. F. Hickling. Pergamon Press, 1968. Illus. 88p. $2. (US). Paperback.

A Guide to Scientific and Technical Journals in Translation. Carl J. Himmelsbach and Grace E. Boyd. Special Libraries Assn., 1968. 47 p. $4.50 (US). Paperback.

Helpful Microorganisms. Daniel N. Lapedes. World Pub. Co., 1968. Photographs, diagrams. 192 p. $4.50 (US).

Kilauea: Case History of a Volcano. Don Herbert and Fulvio Bardossi. Harper, 1968. Illus. by Joyce Ballantyne, photographs. 191 p. $5.95 (US).

A Lifetime with Lions. George Adamson. Doubleday, 1968. 54 Illus. 286 p. Game warden's story of his life in an African game reserve. $5.95 (US).

Animals at Bay: Rare and Rescued American Wildlife. Doubleday, 1968. Illus. by John Schoenherr, 159 p. $3.59 (US).

Conservation and Caribbean Regional Progress. Carl A. Carlozzi and Alice A. Carlozzi. Caribbean Research Inst. (Antioch Press), 1968. Illus. by Christine Sena. 151 p. $4. (US).

Disposal of Process Wastes: Liquids, Solids, Gases. Otto Jaag and others, transl. from German by Max Wulfinghoff. Chemical Pub. Co., 1968. Illus. 240 p. $12.50 (US). Symposium of papers presented at the ACHEMA meeting at Frankfurt/Main, 1964, discussing the nature of contamination of man's environment and suggesting new techniques and equipment to combat the menace.

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A Treasury of Australian Wildlife: Selected Studies from Australian Natural History. D. F. McMichael (Ed.), Ure Smith (Taplinger), 1960. 235 photographs. 354 p. $12.95 (US).

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Essays on Form in Plants. C. W. Wardlaw. Barnes & Noble, 1968. Illus. 399 p. $8.75 (US).

Exploring the Reef. Robert P. L. Straughan. Barnes, A. S., 1968. Color plates, photographs. 248 p. $17.50 (US).

Poisonous Snakes of the World: A Manual for Use by U.S. Amphibious Forces. Granville M. Moore (Ed.). Dept. of the

Navy Bureau of Medicine and Surgery (GOP), 1968. 8 color plates, photographs, drawings, maps. 212 p. $3.25 (US).

Man, Culture, and Animals: The Role of Animals in Human Ecological Adjustments. Anthony Leeds and Andrew P. Vayda (Eds.). Amer. Ass. Adv. Science. 1967. Illus. 304 p. 1965. Second printing $8. (US).

Ground Level Climatology. Robert H. Shaw (Ed.). Amer. Ass. Adv. Science. 1967. 144 illus. 408 p. $12.50 (US).

Residue Reviews: Residues of Pesticides and Other Foreign Chemicals in Foods and Feeds, Vol. 22. Francis A. Gunther (Ed.), Springer-Verlag, N.Y., 1968. 119 p. $9.50 (US).

Biological Clocks and Patterns. Shirley Moore. Criterion Bks., 1968. Illus. by Omar Davis. 133 p. $3.50 (US).

Miraculous Web: The Balance of Life. Natalie Friendly. Prentice-Hall, 1968. Illus. by Bette Fast. 92 p. $3.95 (US).

Field Guide to the National Parks of East Africa. John G. Williams Collins, 1967 or 1968. Indispensable for tourists. Maps, descriptions and checklists of wildlife of 60 East African Parks. 45s UK.

Pesticide Handbook — Entoma, 1968. Donald E. H. Frear. College Science Pubs., 1968, 20th ed. 324 p. Cloth, $4.50; Paperback, $3. (US).

Vegetation and Soils: A World Picture. S. R. Eyre. Aldine Pub. Co., 1968. 2nd ed. 32 plates, diagrams, maps. 328 p. $8.95 (US).
World Without Hunger. Orville L. Freeman. Praeger, 1968. 190 p. $5.95 (US).

Chemical and Biological Warfare: America's Hidden Arsenal. Seymour M. Hersh. Bobbs-Merrill, 1968. 354 p. $7.50 (US). A documented study of U.S. production, policy, research and use of chemical and biological agents.

The Common Scents of Smell: How the Nose Knows and What It all Shows. Russell C. Erb. World Pub. Co., 1968. 142 p. $4.95 (US).

Human Color Perception: A Critical Study of the Experimental Foundation. Joseph J. Sheppard, Jr. Am. Elsevier Pub. Co., 1968. Illus. 192 p. $10. (US).

Man and the Future. James E. Gunn (Ed.), Univ. of Kansas Press, 1968. 305 p. $6.75 (US).

Seals of the World. Gavin Maxwell. Houghton, 1968. 42 photographs. 153 p. $6.95 (US).

Plant Propagation: Principles and Practices. Hudson T. Hartmann and Dale E. Kester. Prentice-Hall, 1968. 2nd ed., Illus. 702 p. $14. (US).

Paddlewheels on the Frontier. Art Downs. Evergreen Preess Ltd. Published by B.C. Outdoors Magazine, 5543 129 Street, RR. 1, Cloverdale, B.C. 74 p. $2.95. Deals with early steamers of British Columbia, it is the result of a great amount of research in old newspapers and historic files.

Canada North. Farley Mowat. McLelland and Stewart, Toronto. 1967. Colored plates, black and white photographs. 127 p. $4.95.

The Caribbean Islands. Mary Slater. Viking Press, 1968. 41 plates, maps. 244 p. $6.95 (US).

Decision Making in National Science Policy. Ciba Foundation Symosium. Anthony de Reuck, Maurice Goldsmith and Julie Knight (Eds), Little, Brown, 1968. 310 p. $12. (US).

Health of Mankind. Ciba Foundation 100th Symposium. Gordon Wolstenholme and Maeve O'Connor (Eds.), Little, Brown, 1968. Illus. 297 p. $12. (US).

Man in the Landscape: A Historic View of the Esthetics of Nature. Paul Shepard. Knopf, 1967. 11 plates. 295 p. $6.95 (US).

Museums and Education. Eric Larrabee, Ed. Smithsonian Institution Press (Random House), 1968. 255 p. $6.50 (US).

Mammals of the World. Ernest P. Walker with Florence Warnick and others. Johns Hopkins Press, 2nd ed., 1968. 1,850 photographs. 1,500 p. Two vols. Slip-cased. $30. (US).

Primitive Nervous Systems. Thomas L. Lentz. Yale Univ. Press, 1968. Illus. 148 p. $7.50 (US).

Taxonomy of American Species of Linden (Tilia). George Neville Jones. Univ. of Ill. Press, 1968. 30 plates. 156 p. $5.95 (US). Paperback.

Trees of North America: A Guide to Field Identification. C. Frank Brockman. Golden Press, 1968. 280 p. 1,000 full color illus. by Rebecca Merrilees. Cloth $5.95; Paperback $2.95 (US).

The Bears and I: Raising Three Cubs in the North Woods. Robert Franklin Leslie. Dutton, 1968. Illus. by Theodore A. Xaras. 224 p. $5.95 (US).

The Biological Time Bomb. Gordon Rattray Taylor. World Pub. Co., 1968. 240 p. $5.50 (US).

The Complete Book of Cat Health and Care. J. J. McCoy. Putnam, 1968. Plates. 237 p. $5.95 (US).

Discover American Trees. Rutherford Platt. Dodd, 1968. 256 p. Photographs by author, illus. by Margaret L. Cosgrove. $4.50 (US). Revised edition of book originally (1952) published as American Trees.

An Environment Fit for People: The New Meaning of Conservation. Raymond F. Dasmann. Public Affairs Pamphlets, 1968. Photographs, paperback. 28 p. 25 c. From 381 Park Ave. South, New York 10016.

McGraw-Hill Directory and Almanac of Canada 1968. Helen Sawyer Hogg, Robert Craig Brown and others, Eds. McGraw-Hill, 3rd ed. Maps. 856 p. $17.50.

Game Bird Hunting in the West. Mike Cramond Mitchell Press. 252 p. $5.95.

The American University: How It Runs, Where It Is Going. Jacques Barzun. Harper, 1968. 319 p. $7.95 (US).

The Central Nervous System and Fish Behavior. David Ingle (Ed.), Univ. of Chicago Press, 1968. Illus. 272 pp. $15. (US).

Evolution and Environment. A Symposium presented on the Occasion of the One Hundredth Anniversary of the Foundation of the Peabody Museum of Natural History. Ellen T. Drake (Ed.). Yale Univ. Press, 1968. Illus. 470 p. $15. (US).

Bamboos: A Gardener's Guide to their Cultivation in Temperate Climates. A. H. Lawson. Taplinger, 1968. Photographs, drawings. 182 p. $12. (US).

The Great Lone Land. A Narrative of Travel and Adventure in the Notrh-West of America. William Francis Butler. Tuttle, 1968. Illus., map. 396 p. An account of a 4000-mile winter journey on horse, on foot and by dogsled, through mostly uninhabited wilderness between Lake Superior and the Rocky Mountains, an expedition commissioned by the Canadian Government in 1871. $5. (US).

How to Follow the Adventures of Insects. V Brown. Little, Brown, 1968. Illus. by Julia Iltis. 201 p. $4.50 (US).

How to Know the Grasses. Richard W. Pohl. Brown, Wm. C., 1968. Rev. ed. 427 illustrations. 244 p. $3.25 (US).

Island of Adventure: A Naturalist Explores a Gulf Coast Wilderness. Ross E. Hutchins. Dodd, 1968. Photographs by author. 243 p. $6. (US).

Molluscs. J. E. Morton. Hillary House Pubs., 1967. Rev. ed. Illus. 244 p. $2.25 (US) Paperback.

The Sockeye Salmon, Oncorhynchus nerka. R. E. Foerster. Fisheries Res. Bd. Canada (Queen's Printer. Ottawa). 1968. 422 p. photographs, diagrams, maps. A study of the sockeye population under a variety of climatic and environmental conditions. An assessment of overall survival as well as

each stage of the life cycle from egg through to adult spawning stages. $8.

Insect Abundance. Fourth symposium of the Royal Entomological Society of London, Sept. 1967. T. R. E. Southwood (Ed.). Published for the Society by Blackwell Scientific Publications, Oxford, England, 1968. Illus. 160 p. $9. (US).

Environment and Change. The Next Fifty Years. Commissioned, William R. Ewald, Jr. (Ed.). American Institute of Planners' Fiftieth Year Consultation. Indiana University Press, Bloomington, 1968. 397 p. Cloth $10; Paperback 4.95 (US)).

Geological Evolution of North America. H. Clark and W. Stearn. Ronald Press. New York, ed. 2, 1968. Illus. 569 p.

Ethics, Politics and Social Research. Gideon Sjoberg (Ed.). Schenkman, Cambridge, Mass., 1967. 358 p. $8.95 (US).

Water Resources Management and Public Policy. T. H. Campbell and R. O. Sylvester (Eds.). University of Washington Press, Seattle, 1968. Illus. 253 p. $9.50 (US).

Odour Description and Odour Classification: A Multidisciplinary Examination. R. Harper, E. C. Smith and D. G. Land. Elsevier, New York, 1968. Illus. 191 p. $7.50 (US).

A BRIEF ON THE FUTURE OF GATINEAU PARK[1]

PRESENTED TO THE NATIONAL CAPITAL COMMISSION, OTTAWA, BY THE OTTAWA FIELD-NATURALISTS' CLUB, SEPTEMBER, 1968

THE OTTAWA FIELD-NATURLISTS' CLUB is anxious that policy and plans for the future of Gatineau Park be established soon so that continued enjoyment of its many features by residents of the National Capital District and by visitors can be assured for a very long time to come. Our primary concern is that this very varied and largely natural area be maintained as such. The close location of such a large wild area to a major city is unique in Canada, but the advantage of such easy accessibility carries the disadvantage that intensity of use is high and growing as the population of the Ottawa district grows.

We can expect that pressure for "improvement" to Gatineau Park will continue and increase. Unfortunately the term "park" carries connotations for most of us of an area heavily modified, "beautified", and with elaborate facilities such as playgrounds, swimming pools, bandstands, lawns and carefully pruned shrubbery. All these are legitimate in their place, but we contend that they are very much out of place in Gatineau Park, which should be a natural park. To this end, we make the following specific suggestions:

1. A large part of Gatineau Park should be retained as a natural area. The northwest sector, around Lac Lapeche, including Curley and Kelly Lakes, seems suitable for this purpose. Road access should be very limited.

[1]Gatineau Park is a Federal Park located in the Province of Quebec but very close to the National Capital.

2. A number of small areas of special interest should be left undisturbed. Among them:
   a. Hopkin's Hole, just west of the Eardley-Masham road. This is a very beautiful but tiny sphagnum mire, a text-book example of the zonation of vegetation during the lake-filling process. There is a tiny open lake surrounded by an open sphagnum mat with an orchid (*Calopogon*), pitcher plants (*Sarracenia*), sundews (*Drosera*) and many other interesting plants, surrounded by a wet black spruce (*Picea*)-tamarack (*Larix*) forest.
   b. Folly Bog, east of the parkway near the informal parking area at the south end of the park. It is a more mature cedar/tamarack fen in crystalline limestone, and supports at least 14 species of orchids.
   c. Meach Lake Marsh, including most of Macdonald Bay, the stream connecting Meach and Harrington Lakes, and the lower end of Flynn's Creek. This area is a regular nesting ground for loons, osprey, herons, bitterns and song birds. It is frequented by beaver, muskrat, mink, otter, possibly fisher, and in winter by deer, fox and smaller mammals.
   d. The area from Wadsworth and Charette Lakes to Lusk Lake to Harrington Lake. This is a beaver and bear area. North of Lac Charette is a bog lake (with acid water, 4 to 5) with a floating mat of vegetation. This is a rare lake type in our region, and it is a nesting area for waterfowl and has many deer.
   e. Esker – about ½ mile from the Eardley-Masham road is the only esker in the park, with a fine stand of beech. This should be preserved as a unique feature; it might be very tempting to use it as a source of gravel.

3. A Park Naturalist should be employed, with duties including the following:
   a. Identification and cataloguing of natural values within the Park.
   b. Advising park management concerning development plans, road location and construction, plant-animal management and conservation.
   c. Developing, supervising and participating in a training program for park rangers.
   d. Developing and guiding the implementation of a public education program of displays, lectures, nature walks, nature trails and other facilities to help visitors to better understand and enjoy the Park's natural history.

4. A long-term plan for park roadways and other facilities should be developed to :
   a. provide reasonable but limited access by vehicles, with minimum damage to the ecology of the area.
   b. keep the road edges natural – there is no point in tidying up the road edges as in a city park. The roads should be bush roads except for good surfacing. Plantings, if needed, should be of native plants.
   c. provide many more parking lots of small size, to give access to walking paths.

We should note here that the existing parkways and parking restrictions give the strong impression that visitors are intended to *drive* through the park, only stopping at points where they must join a crowd. Some of our members, lacking any published information on plans for the park, suggest that road-building be stopped until a complete plan is ready.

5. Where boating is allowed, the use of powerful motors and fast boats should be prohibited. This may now be part of park regulations, we do not know.

6. The growth in size and number of camping areas should be restrained in the park, to preserve its natural character. Campsites and beaches should be developed outside the park when more such facilities are needed.

7. As opportunity and funds permit, private property within Gatineau Park should be eliminated, and with it all agriculture and lumbering. No doubt this is already NCC policy.

8. When there are firm long-term plans for the future of Gatineau Park, they should be publicized widely, thoroughly and repeatedly.

The Ottawa Field-Naturalists' Club has previously offered to assist the NCC in the development of Gatineau Park in any feasible way. This offer is repeated now. The Club has among its members many of the important scientists of the Ottawa area, including outstanding botanists, zoologists and ecologists. Other amateur members are very knowledgeable in their specialties. We can make much of this expertise available from time to time, and will, if it is wanted.

As an example of what we might do, we could arrange botanical exploration of areas where construction is planned and advise whether any rarities should be avoided or moved. We might note that if one particular parking area were extended 50 feet, it would destroy the only known site here for a very rare fern.

This submission is made to bring particular points of view to your attention, and to offer what help we can to achieve our joint objective. We would be pleased to discuss any of the points further with your staffs. It would be very helpful to us if we could be kept generally informed of the plans for Gatineau Park and their progress.

H. N. MACKENZIE,
PRESIDENT,
THE OTTAWA FIELD-NATURALISTS' CLUB,
OTTAWA,

Editor's note: The above brief has subsequently been discussed with the National Capital Commission. The reception was very favorable and arrangements have been made for a continuing exchange of information pertaining to future development of the Park.

BY-LAWS

of

THE OTTAWA FIELD-NATURALISTS' CLUB

1. *Meetings of the General Membership.* The Club shall hold at least two meetings of the general membership each year at which the affairs of the Club shall be discussed.

2. *Duties of the Publications Committee.* The Publications Committee shall have supervision over The Canadian Field-Naturalist and such other publications as directed by the Council. The committee shall have the power to decide what shall appear in publications under its jurisdiction and shall see that the Editors perform their duties in accordance with the Constitution and By-laws.

The Chairman of the committee shall submit to the Council a report which shall be embodied in the annual report of the Council. This report shall give an outline of the work accomplished by the committee during the year.

3. *Duties of the Excursions and Lectures Committee.* The Excursions and Lectures Committee shall make arrangements for field excursions and lecture programs. It shall, in co-operation with other committees, plan the programs for the annual banquet and for the meetings of general membership and notify members of these meetings by special circular.

The Chairman of the committee shall submit a report to the Council at the close of each year outlining the activities carried out under the supervision of the committee. This report shall be embodied in the annual report of the Council.

4. *Duties of the Reserve Fund Committee.* The Reserve Fund Committee shall serve in an advisory capacity to the Council in matters concerning the investment of the Reserve Fund.

5. *Duties of the Editor* of The Canadian Field-Naturalist. The Editor of The Canadian Field-Naturalist shall be responsible for the preparation of The Canadian Field-Naturalist. He shall be the executive officer of the Publications Committee to whom he shall be responsible. He shall be Chairman of an Editorial Committee composed of himself and the Associate Editors of The Canadian Field-Naturalist.

6. *Duties of the Editor of* Trail & Landscape. The Editor of Trail & Landscape shall be responsible for the preparation and distribution of Trail & Landscape. He shall be responsible directly to the Council. He shall be the Chairman of an Editorial Committee composed of himself and the Associate Editors of Trail & Landscape.

7. *Duties of the Associate Editors.* The Associate Editors shall assist the Editors in preparing the publications of the Club.

8. *Duties of the Business Manager.* The Business Manager shall be responsible, under the direction of the Publications Committee, for the custody and sale of the publications owned by the Club and for managing the circulation of The Canadian Field-Naturalist.

9. *Fees.* The schedule of annual fees shall be as follows:

Members:

Individual $5.00
(receives THE CANADIAN FIELD-NATURALIST; also TRAIL & LANDSCAPE if local member. TRAIL & LANDSCAPE to be sent to outside member on request.)

Family $7.00
(receives one copy per household of THE CANADIAN FIELD-NATURALIST; also one copy of TRAIL & LANDSCAPE to be sent to outside member on request.)

Affiliated Societies $20.00

Institutional Subscription $10.00
(receives one copy of THE CANADIAN FIELD-NTURALIST. TRAIL & LANDSCAPE to be sent on request.)

These fees shall take effect January 1, 1969. Fees become due at the beginning of each calendar year. No member in arrears shall be entitled to the privileges of the Club.

10. *Order of Business at Meetings of the Council.*

1. Minutes of the previous meeting
2. Business arising out of the minutes
3. Communications
4. Finances
5. Reports of committees
6. New business

11. *Expulsion From the Club.* An individual may be expelled from the Club for conduct or activities prejudicial to the well-being of the Club by a two-thirds majority vote of the members present at a meeting of the Council, the individual first having had an opportunity to defend himself before a vote is taken.

12. *Amendments.* An amendment to these By-laws may be adopted at any meeting of the Council, by a two-thirds vote of the members present, due notice embodying a copy of the proposed amendment having been given at a previous meeting of the Council. Any such amendment shall be published in an early issue of THE CANADIAN FIELD-NATURALIST.

REPORT OF COUNCIL TO THE NINETIETH ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB

December 9, 1968

During the past year, twelve meetings of Council were held at the National Museum of Canada: January 12, February 9, March 1, April 17, May 2, May 23, June 6, June 20, July 17 August 27, October 1 and November 27, 1968. The Club's business was conducted in the usual orderly manner.

Appointments for 1968 were made as follows:

Editor, The Canadian Field-Naturalist	— T. Mosquin
Business Manager, The Canadian Field-Naturalist	— W. J. Cody
Chairman, Publications Committee	— J. M. Gillett
Chairman, Excursions and Lectures Committee	— E. W. Greenwood
Chairman, Reserve Funds Committee	— R. Frith
Chairman, Membership Committee	— I. Brodo
Chairman, Bird Census Committee	— G. H. McGee
Chairman, Macoun Field Club Committee	— I. Brodo
Chairman, F.O.N. Affairs Committee	—
Chairman, Public Relations Committee	— W. A. Holland
Chairman, Natural Areas Committee	— E. W. Greenwood
Chairman, Constitutional Committee	— T. Mosquin

Report of the Publications Committee

Since the last report of Council four numbers of The Canadian Field-Naturalist have been published. These include Volume 81, Number 4, October-December 1967, containing 72 pages; Volume 82, Number 1, January-March 1968, containing 74 pages; Number 2, April-June, containing 84 pages; and Number 3, July-September, containing 71 pages. The breakdown of items by subject for the four numbers is as follows:

	ARTICLES	NOTES	REVIEWS
Botany	7	7	8
Herpetology	1	3	—
Icthyology	1	2	3
Mammalogy	4	3	3
Ornithology	4	20	11
Miscellaneous	2	2	5

In addition to the above summary there were 22 other items such as Editorials, News and Comment and Special Notices.

The publication of The Canadian Field-Naturalist was again supported by a grant of $500 from the Conservation Committee of the Canadian National Sportsmen's Show. This assistance is gratefully acknowledged.

The Club's popular journal TRAIL AND LANDSCAPE which published articles of a non-technical nature designed for local readership has completed its second successful year of publication. A total of 168 pages were published in six numbers.

Expenditures for THE CANADIAN FIELD-NATURALIST and TRAIL AND LANDSCAPE are recorded in the financial statement of the Club.

REPORT OF THE PUBLIC RELATIONS COMMITTEE

A group named the Centennial Committee headed by G. H. McGee prepared a brochure on birds, botany and geology of the Ottawa area for the information of visitors to the Capital.

The cost of printing 10,000 copies of the brochure was borne by the Tourist and Convention Bureau of the City of Ottawa. The Director, Mr. G. Geldart, stated excellent comments were received from as far as London, England, New York and British Columbia. All copies were distributed. Next year additional copies may be printed by the City, depending on the amount of funds made available.

Various reports on club activities were passed on to John Bird of the Ottawa Journal and Wilfred Bell of the Ottawa Citizen for inclusion in their news columns for which we are very grateful.

It is hoped that by December 31st, a car decal in colour for member identification will have been received from the printers.

REPORT OF THE BIRD CENSUS COMMITTEE

The Committee wishes to report that the forty-ninth consecutive Annual Christmas Bird Count by the Ottawa Field Naturalists' Club was held on Sunday, December 23, 1967.

A total of 8,866 birds of 46 species was reported, compared to 9,404 individuals of 49 species in the 1966 count. However, the number of species equals, and the number of individuals is somewhat higher than, the past 10-year average.

One new species, the Myrtle Warbler, was added to our all time list which now totals 96.

The details of the Census were reported in the Christmas Census edition of the Audubon Field Notes and were included in a tabulation compiled for the Federation of Ontario Naturalists by the Wellington-Waterloo Field Naturalists' Club covering reports from thirty-two participating clubs in Ontario.

REPORT OF THE MACOUN FIELD CLUB COMMITTEE

Membership. The number of members has remained fairly constant from last spring until this fall, even though there is a large "turnover" between the last official meeting in June and the first in September. At the moment, the membership is:

Junior (Grades 4-6) 35[1] (+5 on waiting list)
Intermediate (Grades 7-8) 35 (+2 on waiting list)
Senior (Grades 9-13) 21 (none on waiting list)

[1]The maximum for each group is 35.

Activities. We continued an active field trip program with spring trips to the Dominion Observatory, Ramsey Lake in the Gatineau, the Harry Thompsons' cottage for animal tracking (on snow shoes), and a number of trips to the Macoun Nature Study Area by the Seniors. (More about that below.)

This fall, we have had an "autumn nature" trip to the Macoun Nature Study Area with the Seniors acting as guides, and guided tours through the experimental and display sections of the Plant Research Institute Greenhouses.

We have had a number of excellent speakers for the Senior Meetings, and also for the Intermediate and Junior Meetings.

Macoun Nature Study Area. The Senior group began a study of an area southwest of Bells Corners which they are calling the Macoun Nature Study Area. Some members are more active than others in their projects, but adequate transportation seems to be the limiting factor with most members. We look forward to more serious work this spring.

Library. More books have been added to the growing Club Library, about 40 in the last year, so that we now have approximately 360 books. We hope to continue this rate of growth in the near future since the library continues to be one of our most important and well used facilities.

New Help. To ease the burden of clerical work which falls on the shoulders of the chairman and Michael Shchepanek, the very hard-working assistant chairman, the Information and Education Section of the National Museum agreed to assign a secretary to handle routine matter of applications and inquiries (Mrs. Carmel Dutremble: 992-0483). Mr. Stead's secretary is helping with the typing and stencil needs and Mr. Pat Wohler is again serving us by securing films, looking after requisitions and generally acting as a liaison between the Club and the Museum.

Scholarship Winner for the Red Bay Camp. Arnet Sheppard, a recently "graduated" member of the Macoun Field Club was awarded a scholarship by the O.F.N. Club to attend a two week session at the Federation of Ontario Naturalists' Camp at Red Bay in the Bruce Peninsula. He reported that he learned a great deal and thought it was an extremely valuable experience. This experience is now being passed on to the younger members, since Arnet is helping out with some of the meetings and field trips.

Finances. The committee ran short of funds at the end of the summer (due to unfortunate timing in the billing of our bus charters), and we had to request an additional $50 operating funds. This was approved by Council.

REPORT OF THE EXCURSIONS AND LECTURES COMMITTEE

The committee organized 40 field trips and lectures during 1968, and set up the arrangements for the Annual Dinner.

The general program was quite successful, with all but a very few outings and lectures being well-attended. Our efforts to go beyond simply showing and identifying birds and plants, which comprised two lectures, "Studying

Bird Migration with Radar" and "Canadian Study of Large Meteor Craters" fell flat. Only a handful of our members and the public attended, although both lectures turned out to be simple and most interesting.

The Annual Dinner was successful except financially. We took a beating on reserved attendance because of lack of attendance. Since the club must pay for all reservations, we have recommended that in future all reservations be paid for by the persons making them whether they attend or not.

The membership of the committee in 1968 was:

Chairman: Mr. E. W. Greenwood

Members: Mr. F. M. Brigham
Mr. W. A. Holland
Miss V. Humphreys (consultant)
Dr. W. J. Illman
Mr. and Mrs. B. Lauzon
Mr. and Mrs. H. N. MacKenzie
Mr. G. H. McGee
Mr. L. C. Sherk
Miss M. E. Stuart

REPORT OF THE NATURAL AREAS COMMITTEE

The Committee held no meetings in 1968, and in fact did not manage to organize itself. Nonetheless, some specific actions for conservation were taken, and the ground prepared for some longer-term activity.

The specific items were:

(1) *New Public Campsite on the Corkstown Road.* When this project was announced, the exact location was determined and found out to be precisely where Pink Ladyslipper (*Cypripedium acaule*) has its largest colony close to Ottawa. Negotiations with NCC and the City of Ottawa, and field trips by Mr. MacKenzie and Mr. Greenwood in company with the landscape architects, resulted in a plan for the layout of roads and parking areas which will minimize damage to the orchids and to the other interesting plants there. It was agreed that fencing or any other action which would suggest to the public that something was protected would be not only useless but dangerous. The presence of Poison Ivy (*Rhus radicans*) will be warned of by signs, and since the orchids have finished flowering before many campers arrive, deliberate damage by picking is unlikely.

(2) *Orchid Colonies on the Ottawa River Parkways.* The NCC has been notified of the exact locations of several colonies of the rare orchid *Habenaria flava* which grow where tidying-up in the park areas along the Ottawa River might destroy the plants. The NCC has taken immediate action to locate the colonies and preserve them. If future work endangers the plants, our Club will be notified so that they may be transplanted.

More important than these particular actions has been the initiation of long-term collaboration with the NCC for the future development of Gatineau Park. An *ad hoc* committee discussed what might be Club policy towards Gatineau Park and prepared a draft submisison. This was refined and discussed with the Council, and a final version was submitted to the NCC. It was well received, and Mr. MacDonald of the NCC discussed the OFNC brief with Mr. MacKenzie and Mr. Greenwood. (See page 78.)

There is no doubt that NCC and OFNC desires for the future of Gatineau Park are very much the same. It is agreed that our Club and the NCC will work closely together and keep one another informed, so that the Park may develop as far as possible without preventable damage to its natural history values.

REPORT OF THE RESERVE FUND COMMITTEE

Two investment transactions were completed during the year.

1. Canada Savings Bonds, value $1,700.00, Series 22, were converted to Canada Replacement Bonds Series 24, to take advantage of higher interest rates.
2. As approved by Council, $5,000.00 from current account was invested in Canada Replacement Bonds Series 24, June 1968. These bonds remain in current account and are available in cash on demand.

REPORT OF THE MEMBERSHIP COMMITTEE

The Membership Comittee was relatively inactive this year. Programs initiated last year, however, were carried on this year.

(a) Letters of acceptance were sent out to all new (non-institutional) members.

(b) Introductory brochure – membership application forms were made available to field trip leaders, the treasurer, the public relations chairman, teachers of natural history, etc.

(c) Letters inviting Macoun Club parents to join were sent out and had a fairily good response.

MEMBERSHIP TOTALS

Active and Subscribers	973
Associate	108
Honorary	5
Life	9
	1,095

STATEMENT OF FINANCIAL STANDING
THE OTTAWA FIELD-NATURALISTS' CLUB NOVEMBER 30, 1968

CURRENT ACCOUNT

Assets

Balance in Bank Nov. 30, 1968.	$ 3,615.16
Bills receivable	1,212.83
	$ 4,827.99

Liabilities

Cheques outstanding	$ 250.00
Balance	4,577.99
	$ 4,827.99

Receipts

Balance, Nov. 30, 1967		7,214.40
Fees: Current	$4,637.29	
Arrears	80.00	
Advance	746.15	
Associate	333.15	
		5,796.59
Separates & Illustrations		1,601.78
Back Numbers (incl. Transactions)		1,084.26
Geologies		98.25
Donation, C.N. Sportsmen's Show		500.00
Godfrey "Birds of Canada"		25.00
Macoun Club Collections		80.50
Trail & Landscape copies		65.15
Interest on Bonds		262.50
Miscellaneous		44.16
U.S. Premium		146.73
		$16,919.32

Expenditures

Can. Field Naturalist	3,989.09
Separates & Illustrations	1,330.86
Editor's Honorarium	200.00
Business Mgr's. Honorarium	100.00
Book keeping System	373.46
Postage, Stationery & Supplies	572.45
Treasurer's Clerical Assistance	71.50
Orchid Survey	90.56
F.O.N. Camp: Arnett Sheppard	155.00
Excursions & Lectures Comm.	114.10
Macoun Field Club	297.23
Trail & Landscape	1,014.83
Bonds for Reserve Acct.	5,045.67
Miscellaneous	151.77
Bank Exchange Charges	47.64
Bank Balance Nov. 30, 1968 $3,615.16 less o/s cheques 250.00	3,365.16
	$16,919.32

RESERVE FUND

Assets

Can. Savings Bonds S22	$ 6,500.00
$2,000 H.E.P.C. 3% bonds, market value	1,920.00
30 shares Bell Telephone, market value	1,432.50
Bank Bal. Nov. 30, 1968	188.63
	$10,041.13

Liabilities

Nil

Receipts

Bank Bal. Nov. 30, 1967	58.56
Bank Interest	2.57
H.E.P.C. Bond interest	60.00
Bell Telephone dividends	75.00
	$ 196.13

Expenditures

Safety deposit box rental	7.50
Bank Balance Nov. 30, 1968	188.63
	$ 196.13

PUBLICATIONS FUND

Assets

Can. Savings Bonds S22	$ 200.00
$1,500 H.E.P.C. 3% bonds, market value	1,440.00
5 shares Bell Telephone, market value	238.75
Bank Balance Nov. 30, 1968	121.29
	$ 2,000.04

Liabilities

Nil

Receipts

Bank Balance Nov. 30, 1967	$ 61.58
Bank interest	2.21
H.E.P.C. Bond interest	45.00
Bell Telephone dividends	12.50
	$ 121.29

Expenditures

Bank Balance Nov. 30, 1968	$ 121.29
	$ 121.29

Audited and found correct (Signed)
J. M. Gillett and D. E. McAllister, Auditors

(Signed) L. G. Howden, Treasurer

The CANADIAN FIELD-NATURALIST

Published by THE OTTAWA FIELD-NATURALISTS' CLUB, Ottawa, Ontario

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Guest Editorial

The DDE Affair — J. A. KEITH

Articles

Significance of Chlorinated Hydrocarbon Residues to Breeding Pelicans and Cormorants — DANIEL W. ANDERSON, JOSEPH J. HICKEY, ROBERT W. RISEBROUGH, DONALD F. HUGHES and ROBERT E. CHRISTENSEN

Vegetation of a Prairie Near Winnipeg, Manitoba — M. H. LEVIN and G. M. KELEHER

Observations on Wolves at a Rendevous Site in Algonquin Park — JOHN B. THEBERGE and DOUGLAS H. PIMLOTT

The Status of the Pine Marten in Newfoundland — ARTHUR T. BERGERUD

Fishermen's Reports of Freshwater and Saltwater Migrations of Nova Scotia Eels (*Anguilla rostrata*) — J. CARL MEDCOF

Nesting of the Long-tailed Jaeger in Southwest Yukon Territory – An Extension of the known Breeding Grounds — LARRY W. PRICE

Laboratory Studies of Interactions between the White-footed Mouse and Redback Vole — LOWELL L. GETZ

Some Trichoptera of the Hubbard Brook Experimental Forest in Central New Hampshire — KENNETH MCCONNOCHIE and GENE E. LIKENS

Notes

Postmetamorphic Basking Aggregations of the Boreal Toad, *Bufo boreas boreas* — JEFFREY HOWARD BLACK and JUDITH NORENE BLACK

A Reconsideration of the Relationship of *Barbula johanseni* (Musci) — HOWARD CRUM

Notes on Birds of the Iron Bridge, Ontario, Region — W. EARL GODFREY

Vertical Distribution of White Perch, *Roccus americanus* Modified by Light — A. N. SHERI and G. POWER

Striped Mullet, *Mugil cephalus*, Records from Halifax County, Nova Scotia, in 1966 and 1968 — JOHN GILHEN

Puccinellia ambigua Th. Sør., New to the Hudson Bay Region — A. E. PORSILD

Red-tailed Hawks Nesting on Cliffs in Ontario — ROBERT F. ANDRLE

Clethraceae: A Plant Family New to Canada — P. M. TACHEREAU

Supernumerary Teeth in a Brown Lemming from Barrow, Alaska — DAVID L. CHESEMORE

Studies of the Bryon Bog in Southwestern Ontario. XXXVII. Leeches (Hirudinea) Collected in the Bog — WILLIAM W. JUDD

(*continued on outside back cover*)

Can. Field Nat. | Vol. 83 | No. 2 | p. 89-188 | Ottawa, April-June, 1969

THE OTTAWA FIELD-NATURALISTS' CLUB

FOUNDED IN 1879

— Patrons —

THEIR EXCELLENCIES THE GOVERNOR GENERAL AND MRS. ROLAND MICHENER

The objectives of the Club are to promote the appreciation, preservation and conservation of Canada's natural heritage; to encourage investigation and publish the results of research in all fields of natural history and to diffuse information on these fields as widely as possible; to support and co-operate with organizations engaged in preserving, maintaining or restoring quality environments for living things.

The club is a corporate member of the Federation of Ontario Naturalists.

MEMBERS OF COUNCIL

President: HUE N. MACKENZIE, 228 Royal Avenue, Ottawa, Ontario.
First Vice-President: THEODORE MOSQUIN.
Second Vice-President: W. A. HOLLAND.
Secretary: ALEXANDER W. RATHWELL, Canadian Wildlife Service, 400 Laurier Avenue West, Ottawa 4, Ontario.
Treasurer: F. M. BRIGHAM, Box 3264, Postal Station C, Ottawa 3, Ontario.
Additional Members of Council: W. K. W. BALDWIN, E. L. BOUSFIELD, I. M. BRODO, D. BRUNTON, W. J. CODY, BARBARA COLEMAN, JOYCE M. DUNSTON, R. Y. EDWARDS, J. M. GILLETT, E. W. GREENWOOD, ANNE HANES, D. D. HOGARTH, LUELLA HOWDEN, W. I. ILLMAN, LOIS KINGSTON, D. LAFONTAINE, F. LEBLANC, G. H. MCGEE, PATRICIA NARRAWAY, A. E. PORSILD, L. C. SHERK, J. H. SOPER, MARY STUART, H. E. SWEERS, SHEILA THOMSON.
Auditors: J. M. GILLETT and L. G. HOWDEN.

THE CANADIAN FIELD-NATURALIST

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PHILLIP M. YOUNGMAN (*Mammalogy*), National Museum of Natural Sciences,

Business Manager: W. J. CODY, Plant Research Institute, Central Experimental Farm, Ottawa.

MEMBERSHIP AND SUBSCRIPTION

The annual membership fee of $5.00 for individuals covers subscription to the journal. Libraries and other institutions may subscribe at the rate of $10.00 per year (volume). Applications for membership, subscriptions, changes of address and undeliverable copies should be mailed to: Treasurer, Ottawa Field-Naturalists' Club, Box 3264, Postal Station 'C', Ottawa 3, Ontario, Canada. Return postage guaranteed.

Second class mail registration number 0527

The Canadian Field-Naturalist

VOLUME 83 APRIL-JUNE, 1969 NUMBER 2

THE DDE AFFAIR

WITHIN the past few years, a number of research leads have fallen into place to form one particular picture of biocide side effects that is unusually complete and adds new legitimacy to the long-voiced concern over the widespread distribution of low levels of residues of DDT.

This picture involves the relationship between chlorinated hydrocarbons and declining populations of raptorial birds with abnormally thin eggshells, and some of its aspects were dealt with in the editorial of the October-December issue. Unlike some proposed side-effects of pesticides, the evidence for this relationship is extremely convincing. The fact that a decline in eggshell weight of British Peregrines and Sparrowhawks coincided both with the widespread introduction of DDT and with a decline in their reproductive success could possibly have been called mere coincidence until the same association was shown to hold for declining populations of Peregrines, Bald Eagles and Ospreys in North America but, most significantly, not to hold for stationary populations of Red-tailed Hawks, Golden Eagles, and Great Horned Owls. There is also now excellent evidence for a mechanism; DDT, its most widespread metabolite DDE, and PCB (the polychlorinated biphenyls), have all now been shown to induce enzymes in birds that degrade steroids which in turn control eggshell formation. And, finally, an inverse correlation has been established between DDE residues in individual eggs and the thickness of their shells.

This group of results marks a turning point in research into pesticide side effects and their resource management implications. For five years this research has been demonstrating the fantastically thorough dispersion of residues of organochlorine insecticides throughout the biosphere, but has been unable to show significant population effects. And to make these effects seem even less likely, the most abundant and widely dispersed of these residues is DDE, a metabolite of demonstrably lower acute toxicity than its relatively non-toxic parent, DDT. But now it is clear that DDE itself is a thoroughly capable steroid degrader, and there is little doubt that by this means it is a cause of the declines of those populations of birds which have substantial DDE residues and abnormally thin eggshells.

This gives a most unfortunate new significance to all those recent studies documenting the universal contamination of the biosphere with DDE. For here is a consistent component of the diet and bodies of many entire populations of higher vertebrates that increases enzyme activity in the liver and can critically interfere with endocrine functions. Work presently underway in Canada is documenting the now-expected patterns of universal DDE distribution at very uneven concentrations, with population declines in some populations with high

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residue levels. This distribution ranges from resident arctic animals and Atlantic seabirds quite out of contact with areas of DDT use, to animals in New Brunswick forests, urban areas, and open farm country, that all share some history of exposure.

The central significance for biological research is that vertebrate populations, particularly of carnivores and even in the most remote regions, can no longer be considered without proof to have normal endocrine functions. Future studies, particularly of reproductive success and behaviour, must, to be taken seriously, include assays for DDE and similarly active materials. For some species populations with relatively high DDE concentrations, such as many bird- and fish-eating birds, it will no longer be possible to find sufficiently uncontaminated control populations with which to determine either normal patterns or the degree of abnormality induced by DDE.

The central significance for environmental pollution research is that it has hopelessly failed. For these decisive studies showing critical DDE effects in Europe and North America come after 20 years of large-scale DDT use and small-scale side-effect research, and at the point where, in these countries, DDT use is declining anyway and ironically for different reasons, principally the development of resistant strains of insects. If environmental pollution research cannot be supported to a much greater and more coherent extent in the future, and so achieve results in time spans that have any relevance to the problems, then this research is merely a sop to the conscience of the scientific community, a pretense with no real function in resource management.

The central significance of this DDE affair for overall resource policy in Canada is that there exists no effective mechanism for preventing such resource degradations by toxic chemicals now or in the future. In the case of pesticides, despite new legislation, there is, absurdly, no requirement that individual pesticide uses be justified ecologically, that their total benefits outweigh their environmental costs. And pesticides, at least, are formally scrutinized before being sold in the market, but what of potential industrial contaminants, such as the polychlorinated biphenyls?

The last editorial on this subject challenged the scientific community to follow up the fascinating research leads now open in biocide side-effect studies. This one challenges resource policy makers to look at the DDE affair, recognize the futility of the present scale of side-effect research, and either greatly expand this research and formally integrate its results at the appropriate time into resource planning, or admit that short term goals are their only interest and that rational planning is beyond them.

J. A. KEITH,
Canadian Wildlife Service,
Ottawa.
April 11, 1969.

SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS

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Introduction

This paper reports levels of chlorinated hydrocarbons present in eggs and spring food of Double-crested Cormorants (*Phalacrocorax auritus*) and White Pelicans (*Pelecanus erythrorhynchos*) and the effects the residues might have upon the reproductive physiology of these species. On the basis of research concerning fat-kinetics in certain migratory birds (Hanson 1962, Weise 1963, Brenner 1967, and others), there is good reason to believe that residues in the eggs provide a reliable index to fat-stored contamination in the female, especially in birds with small clutches. The precise relationships have yet to be studied in detail (Lockie 1967, Stickel 1968).

Study Areas and Methods

Study Areas

Sampling was conducted in the summer of 1965 on 19 lakes and impoundments in 10 watersheds of the prairie states and provinces (Figure 1). Eleven cormorant and five pelican colonies were involved. Pesticides used locally now or in the recent past in most of our study areas included most commonly DDT, Aldrin, Dieldrin, Sevin, Toxaphene, and mercury seed-dressings. Toxaphene used for fish control in the Dakotas was a potential contaminant (Henegar 1966, Needham 1966), although it would likely be distributed in a nonrandom pattern. Toxaphene has been shown to be an important local contaminant in fish-eating birds (Rudd 1964:259; and J. O. Keith, *personal communication*). Dieldrin use at a rate of 2 oz/acre in North Dakota and southern Manitoba and Saskatchewan has in the past been widespread during heavy grasshopper outbreaks. In the other Canadian areas we sampled, known insecticide use appeared to be very slight or negligible. Chlorinated hydrocarbons of pesticide or industrial origin have been detected as fallout in rainwater in England (Wheatley and Hardman 1965, Tarrant and Tatton 1968), in rainwater and dust in Ohio (Cohen and Pinkerton 1966), in airborne particles over the Atlantic Ocean (Risebrough et al. 1968*a*) and in resident wildlife of Antarctica (Tatton and Ruzicka 1967). Local minor usage or nonuse therefore does not

necessarily mean that residues will not be detected. The industrial pollutants include the polychlorinated biphenyls (PCB's) which, like the insecticides, are now widely distributed in wildlife (Jensen 1966, Widmark 1967, Holmes et al. 1967, Risebrough et al. 1968*b*, Koeman et al. 1969).

Sampling and Pooling

Fish were sampled by angling, gill-netting, and by picking up regurgitated meals. To minimize the effects of digestion, only whole regurgitated fish were taken. We pooled 329 of these fish for chemical analysis by segregating fish of approximately the same age and weights from each area. Fish up to 5 lb were occasionally seen as pelican meals, although both pelicans and cormorants left materials at their colonies that were composed of minnows and fish up to 1 or 2 lb. We observed no other cold-blooded vertebrates or invertebrates in the regurgitated boluses at the colonies at the time of sampling. Where differences in fish size were encountered, we used equal volumes of ground material to give each fish equal representation in the pool. The fish were completely wrapped in aluminum foil and frozen (−23°C) until preparation for chemical analysis (1 to 3 months following collection).

A total of 89 cormorant and 54 pelican eggs were collected, one from each nest sample, in a pattern distributed as evenly as possible across the long axis of each colony. These were combined into 59 pools for chemical analysis. The field-collected eggs were wrapped individually in aluminum foil and kept frozen until analysis as above with fish. No attempt was made to collect eggs that we found on the ground outside of nests. We attempted to pool eggs of roughly equivalent incubation stages for each colony and species. Disparity of breeding schedule in pelicans (Shaller 1964, Diem and Condon 1967) may bias samples to a subcolony rather than truly represent the entire breeding population for a given location. This problem needs further research. Different breeding units in a given colony, i.e., groups with separate, distinct phenologies, may represent different wintering groups (Ward 1924, Diem and Condon 1967), or groups with similar physiological conditioning for breeding (Shaller 1964). They may also represent renesting or younger birds, especially if found on the periphery of their colony site.

Laboratory Analyses

ORIGINAL ANALYTICAL PROCEDURE. WARF Institute, Inc. (formerly The Wisconsin Alumni Research Foundation, referred to following as WARF) conducted the laboratory analyses. The original analytical procedure followed methods outlined by the U.S. Food and Drug Administration (USFDA 1965).

All samples were ground and then homogenized in a blender. Subsamples were then mixed with sodium sulphate. The latter were extracted for eight or more hours in a Soxhlet apparatus with ether:petroleum ether (70:170). After the samples had been extracted in the Soxhlet apparatus, they were made up to 50-ml volumes and divided into two portions. One portion was cleaned-up by passing it through a florisil column (USFDA 1965). The solvent comprised 150 to 200 ml of ethyl ether:petroleum ether in the first elution. The proportion of ethyl ether was 3 to 5%, depending on the activation of the florisil.

FIGURE 1. Map showing locations of pelican and cormorant breeding colonies used for pesticide studies in 1965. Locations are numbered as follows: 1. Lake DuBay, Wis.; 2. Agassiz National Wildlife Refuge (NWR), Minn.; 3. Chase Lake NWR, N.D.; 4. Lake Garrison, N.D.; 5. Upper Souris NWR, N.D.; 6. Salyer (formerly Lower Souris) NWR, N.D.; 7. Dog Lake, Man.; 8. Lake Winnipegosis, Man.; 9. Suggi Lake, Sask.; 10. Moose Lake, Man.; 11. Pelican Lake, Man. Nesting pelicans were sampled at Chase Lake, Dog Lake, Suggi Lake, Moose Lake, and Pelican Lake.

The second elution was comprised of 220 to 250 ml of the same solvents but with 15% ethyl ether. The extracts were analyzed with gas chromatographs (GC) (Barber Coleman, model GC 5000, and Jarrell-Ash, model 28-700) equipped with electron-capture detectors. The glass columns were ¼-inch by 4-ft, packed with 5% DC-200 (12,500) on Cromport XXX. The column temperatures were 210°C. The flow rate of nitrogen was 75 cc/minute.

The second portions of the subsamples were used for fat determinations. These portions were placed in preweighed beakers and dried first over a steam bath and then transferred to a 40°C oven for 2 to 4 hours. The beakers were then reweighed, weight of fat doubled, and the per cent fat calculated on the basis of the original "fresh" weight of the extracted sample.

Solvent and glassware blanks showed no interfering peaks which would interfere with the determination of DDT and PCB compounds. Recoveries, using this procedure, from egg and tissue samples spiked with DDE, TDE, DDT, or Dieldrin, with levels greater than 0.05 ppm, have been tested by WARF chemists and found to be 85 to 100 per cent (F. B. Coon, *personal communication*).

SAPONIFICATION, REANALYSIS, AND REINTERPRETATION OF ORIGINAL CHROMATOGRAMS. The recent discovery of polychlorinated biphenyls in British, Swedish, and North American wildlife samples and their possible interference with the determination of other compounds prompted us to reevaluate our original findings. Five extracts of eggs were randomly selected from the original series, rerun again on the GC in 1969, then treated with alcoholic KOH (USFDA 1968; Risebrough et al., in press, 1969) and analyzed for the third time on the GC.

The polychlorinated biphenyls are mixtures of compounds which differ in the number and the position of the chlorine atoms on the biphenyl molecule. The commercial preparations are graded according to their average chlorine content. A chromatogram on a DC-200 column of Aroclor 1254, the average chlorine content of which is 54%, is shown in Figure 2*a*. The PCB peaks labelled 8, 9, and 10 have retention times on DC-200 columns, relative to *p,p'*-DDE, of 1.25, 1.48, and 1.75. They were usually the most conspicuous of the PCB peaks in our chromatograms obtained with electron capture detectors. These three compounds also constitute a large fraction of the total polychlorinated biphenyl in the Aroclor 1254 mixture.

Peak 8 with retention time 1.25 may thus interfere with the determination of *p,p'*-TDE, which has a retention time of 1.27 on DC-200 columns. Similarly, peak 10 may interfere with the determination of *p,p'*-DDT, which has a retention time of 1.68. On this column, however, peak 9 with retention time 1.48 does not interfere with the determination of any of the DDT group. Although PCB peak at 1.25 is selectively degraded by ultraviolet light (Risebrough et al., in press, 1969), most of our chromatograms of wildlife extracts indicated that peaks 8, 9, and 10 had approximately the same height. From

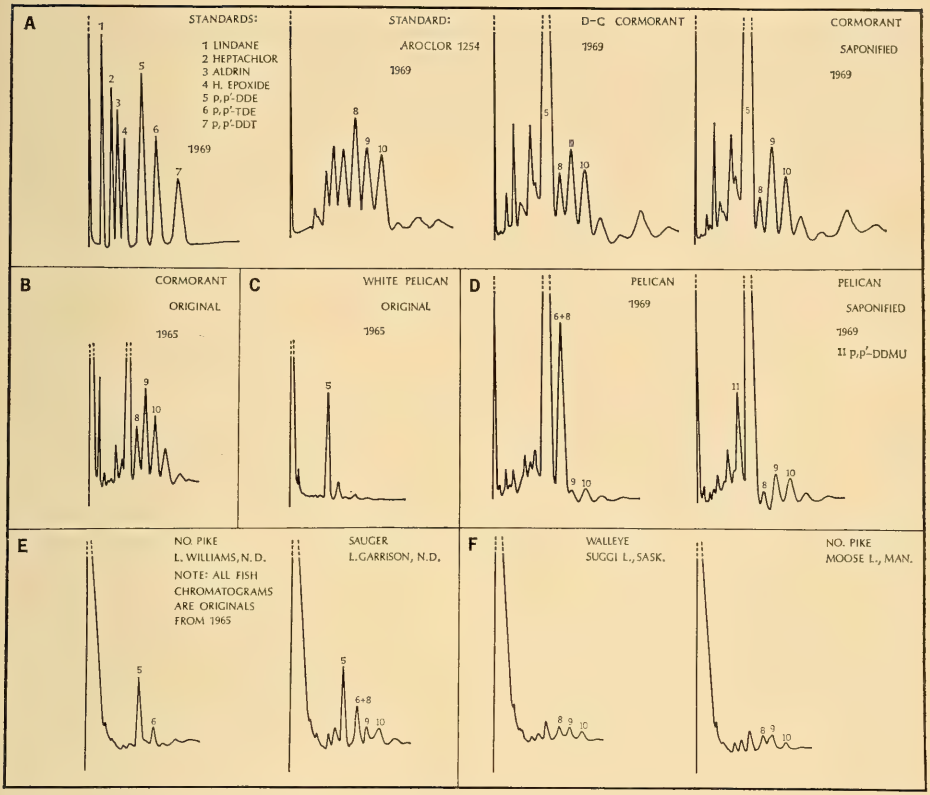


FIGURE 2. Examples of chromatograms of egg and fish extracts under different treatments, showing their different basic characteristics and responses. These chromatograms do not represent specially selected examples. The 1969 GC runs, the "original" chromatograms from 1965, and the fish chromatograms are each traced on their own scales and represent different recorders on the DC-200 column. A. Standards, the original, and saponified extracts of cormorant eggs. The standards represent an injection of 0.05 micrograms per ml each of *p, p'*-TDE and *p, p'*-DDT and 0.4 micrograms per ml of Aroclor 1254. The conversion factor of 10 (see text) was estimated from these differences as well as differences in peak responses. The cormorant extracts (1969) show little change in DDT-TDE interfering peaks upon saponification, suggesting little or no presence of DDT or TDE. The *p, p'*-DDE is off-scale on these cormorant chromatograms and is indicated by a dashed line, as are following example. B. Original chromatogram of cormorant egg extracts from Dog Lake, Manitoba. C. Original chromatogram of pelican egg extracts from Moose Lake, Manitoba. D. Original and saponified extracts of white pelican eggs from Chase Lake, North Dakota, showing conversion *p, p'*-TDE, revealing smaller peaks underneath. E. Original chromatograms of fish extracts (locations are given in diagram), suggesting prevalence of DDE, TDE, and DDT, in that order, superimposed on a backbround of PCB's. F. Same as E, but from our northernmost sampling sites, showing a general PCB pattern with possibly very small amounts of *p, p'*-DDE present.

visual examination of the chromatograms of the cormorant egg extracts in Figures 2*a* and 2*b* it was therefore possible to conclude that there was relatively little or no *p,p'*-TDE or *p,p'*-DDT in the extract. In the chromatograms of the unsaponified extracts of the pelican egg in Figures 2*c* and 2*d*, however, the peak after DDE was much higher than the PCB peaks which followed. It would consist, therefore, mainly of *p,p'*-TDE. Since peak 10 was approximately as high as peak 9, it likely consisted mainly of PCB and not *p,p'*-DDT.

Saponification of extracts converts *p,p'*-DDT to *p,p'*-DDE and *p,p'*-TDE to *p,p'*-DDMU but does not affect the PCB compounds (Risebrough et al., in press, 1969). The profile of the cormorant chromatogram was therefore unchanged with saponification, but the profile of the pelican chromatograms changed after saponification because of the conversion of *p,p'*-TDE to *p,p'*-DDMU.

In order to obtain correlation coefficients between PCB content and eggshell thickness, it was necessary to estimate the relative PCB concentrations. On a strictly empirical basis, it was found that Aroclor 1254 could be quantified by considering peak 10 as *p,p'*-DDT and multiplying that value by 10. Since peak 10 had originally, in most cases, been quantified as *p,p'*-DDT, and since many of the original extracts contained little or no *p,p'*-DDT, it was possible to obtain a crude estimate of PCB by visual examination of the chromatograms.

Five extracts originally prepared in 1965 were saponified in 1969 to remove interfering *p,p'*-DDT and *p,p'*-TDE. For these samples, PCB was quantified as Aroclor 1254 by relating peaks 9 and 10 to the corresponding peaks of chromatograms of standard Aroclor 1254. The results obtained by the two methods are presented in Table 1.

One or more PCB compounds may emerge at approximately the same time as *p,p'*-DDE, but it is evident from the chromatograms of Figures 2*a*, *b*, *c*, and *d* that the DDE peak was always much higher than the PCB peaks and that there was no significant PCB interference in the determination of DDE. This seems generally true for extracts of North American wildlife (Risebrough et al. 1968*b*) but chromatograms of extracts of a European Kestrel (*Falco tinnunculus*) (Holmes et al. 1967) and a Common Eider (*Somateria mollissima*) (Koeman et al. 1969) suggest that PCB may be more abundant than DDE as an environmental pollutant in some areas of Europe. Moreover, some of the PCB compounds with lower molecular weights, including those interfering with *p,p'*-DDE on QF-1 columns may be selectively metabolized (Risebrough and Anderson, in preparation).

The eggs were measured as described by Anderson and Hickey (1969). Because they showed geographical variations in egg size, shell weight, and shell thickness, it became necessary to compare eggs from the same geographical areas.

The residues are presented as ppm wet weight ("fresh" weight) unless otherwise stated. Chlorinated hydrocarbon insecticides in general are pre-

TABLE 1. — Residue estimates of five cormorant and pelican egg pools by four methods, using the DC-200 column[1]

Sample No.-Species	Treatment	Per Cent Water	Per Cent Fat	Residue Determinations in ppm Wet-weight				
				Dieldrin	*p, p'*-DDE	*p, p'*-TDE	*p, p'*-DDT	Est. Aroclor
LSE-2-CORMORANT	1	84.7	3.2	0.10	2.8	0.20	0.30	—
(Salyer NWR, N.D.)	2	85.0	2.5	0.05	3.1	NE	NE	—
	3	—	—	NE	4.3	0.04	0.00	4
	4	—	—	NE	NE	0	0	3
DUE-1-CORMORANT	1	82.9	5.0	0.80	45.0	1.05	2.80	—
(Lake DuBay, Wisc.)	2	84.4	4.4	0.44	44.0	NE	NE	—
	3	—	—	NE	44.0	0.18	0.00	23
	4	—	—	NE	NE	T	0	28
WNE-11-CORMORANT	1	83.3	5.0	0.45	18.0	0.50	1.40	—
(L. Winnipegosis, Man.)	2	83.5	6.5	0.28	22.8	NE	NE	—
	3	—	—	NE	20.0	0.35	0.44	23
	4	—	—	NE	NE	T	0	14
CHE-7-WHITE PELICAN	1	82.1	4.5	0.10	2.5	0.60	0.20	—
(Chase Lake, N.D.)	2	83.6	3.8	0.05	2.5	NE	NE	—
	3	—	—	NE	2.6	0.47	0.00	1
	4	—	—	NE	NE	0.60	0.10	1
SUE-8-WHITE PELICAN	1	82.5	4.3	0.15	2.2	0.25	0.20	—
(Suggi Lake, Sask.)	2	85.2	4.1	0.07	2.4	NE	NE	—
	3	—	—	NE	2.8	0.18	0.05	1
	4	—	—	NE	NE	0.20	0.15	1
Mean Deviation Between Methods 1 and 2		+1.2	−0.1	−0.14	+0.82	—	—	—
Per Cent Difference from Original Value		+1.4	−4.5	−43.8	+5.8	—	—	—
Mean Deviation Between Methods 1 and 3		—	—	—	—	−0.30	−0.88	—
Per Cent Difference from Original Value		—	—	—	—	−57.7	−89.8	—

[1]Residue analysis methods are numbered as follows (see text):

1. Standard GC in 1965 (USFDA 1965).
2. Standard GC in 1969 (USFDA 1968), TDE and DDT not estimated (NE).
3. Standard GC in 1969, TDE and DDT estimated by change in peak heights with saponification.
4. Visual examination of chromatograms using criteria described in text. When PCB interference was considered negligible, as for the TDE value of CHE-7, the original value was retained. In others, per cent interference was estimated, recorded as a fraction of the original, present in trace amounts (T), or absent (0).

TABLE 2. — Chemical names of compounds discussed in the text

p, p′-DDE	1, 1-dichloro-2, 2-bis (p-chlorophenyl) ethylene
p, p′-DDT	1, 1, 1-trichloro-2, 2-bis (p-chlorophenyl) ethane
p, p′-TDE (DDD)	1, 1-dichloro-2, 2-bis (p-chlorophenyl) ethane
p, p′-DDMU	1-chloro-2, 2-bis (p-chlorophenyl) ethylene
Aldrin	Not less than 95% of 1, 2, 3, 4, 10, 10-hexachloro-1, 4, 4a, 5, 8, 8a-hexahydro-1, 4-*endo-exo* 5, 8-dimethanophthalene
Sevin	1-naphthyl methylcarbamate
Dieldrin	Not less than 85% of 1, 2, 3, 4, 10, 10-hexachloro-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4-*endo-exo*-5, 8-dimethano-naphthalene
Endrin	1, 2, 3, 4, 10, 10-hexachloro-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4,-*endo-endo*-5, 8-dimethanonaphthalene
Heptachlor epoxide	1, 4, 5, 6, 7, 8, 8-heptachloro-2, 3-epoxy-3a, 4, 7, 7a-tetrahydro-4, 7-methanoindan
Toxaphene	chlorinated camphene containing 67% to 69% chlorine
PCB	chlorinated biphenyl
Lindane	1, 2, 3, 4, 5, 6-hexachlorocyclohexane, 99% or more gamma isomer

sented as "CH" in further discussion. *p,p′*-DDT plus its various metabolites are referred to collectively as "DDT-family" residues. The technical names of the compounds discussed in this text are listed in Table 2.

Statistical Analyses

Statistical analyses used in this study followed Steel and Torrie (1960). Most data were analyzed with an IBM 1620 computer.

RESULTS AND DISCUSSION

Residue Levels

No fish pools (Table 3) from our sample approached levels greater than 0.1 ppm (parts per million) of *p,p′*-DDE (< 0.08 ppm from a Lake Garrison, N.D., sauger pool). No Dieldrin values for fish exceeded 0.015 ppm. Heptachlor epoxide (HE), Endrin, Aldrin, and Toxaphene were not detected in any of the fish pools. PCB residues were detected in all fish samples, but were usually present in trace amounts (Table 3 and Figures 2*e*, *f*). Since laboratory solvent and glassware blanks showed no evidence of PCB contamination, it would appear that the presence of PCB in fish from remote areas suggests widespread aerial fallout. Although there is substantial evidence for aerial fallout of both DDT and PCB in pelagic areas (Risebrough et al. 1968*b*) we believe that further sampling is necessary to show that this PCB was derived from aerial fallout.

The mean residues for cormorant and pelican eggs were expectedly higher than those for fish (Table 3). Dieldrin, *p,p′*-DDE, and PCB's were universal in all the egg pools, whereas HE (0.3 to 0.5 ppm associated with higher levels of all residues) was detected in only three cormorant egg pools, one from Dog Lake, Manitoba and two from Pelican Lake, Manitoba. The highest cormorant egg residues were 45.0 ppm of *p,p′*-DDE and 28 ppm of estimated PCB's. These were from Lake DuBay, Wisconsin. The highest DDE residues from pelican eggs were from Pelican Lake, Manitoba and ran 4.8 ppm. PCB residues in this same sample were present in trace amounts. Our highest estimate for PCB's in pelicans was 1.2 ppm from two egg pools, one from Moose Lake,

TABLE 3. — Residue levels (*ppm* wet weight) in selected components of the food web of breeding cormorants and pelicans

Species Grouping	No. Areas or Colonies	No. Pools[2]	Residues Detected:[1]							
			p, p'-DDE		Est. PCB		*p, p*-TDE		*p, p*-DDT	
			PPM[2]	%F[3]	PPM[2]	%F	PPM	%F	PPM	%F
Mean residues ± Standard Error										
Interior cormorant										
First nest	9	29	11.0±1.73	100	9	100	T	3	0.2±0.03	10
Renest	2	6	7.3±3.02	100	5	100	ND[4]	0	ND	0
Live eggs	8	26	11.1±1.90	100	8	100	ND	0	0.1±0.03	8
Dead eggs	8	9	8.2±2.33	100	8	100	T	11	T	11
All eggs	11	35	10.4±1.53	100	8	100	T	3	0.2±0.03	9
Interior pelican										
First nest	4	16	1.7±0.26	100	0.5	100	0.4±0.06	88	0.1±0.02	50
Renesters	1	4	1.6±0.35	100	1.1	100	0.3±0.08	100	0.1±0.01	100
Live eggs	5	11	1.9±0.32	100	0.7	100	0.4±0.07	100	0.1±0.02	73
Dead eggs	5	9	1.4±0.28	100	0.6	100	0.3±0.08	78	0.1±0.01	44
All eggs	5	20	1.7±0.22	100	0.6	100	0.4±0.05	90	0.1±0.01	60
Residues in range ppm										
Fish[5]	11	32	T–0.08	70	T–0.5[6]	100	T–0.04	13	T–0.01	13

[1]HE was also detected in 3 cormorant egg pools, Dieldrin was detected in all egg pools but no levels exceeded 0.4 ppm.
[2]Pools consisted of 2 and 3 eggs and occassionally single cormorant eggs. Variances in DDE were not significantly different when single eggs and pools 2 and 3 were compared in both species (Steel and Torrie 1960:83; comparison of *F*-values, where F = larger s^2/smaller s^2). No standard errors are reported for PCB's at this time, due to the nature of their estimates. T (eggs) = < 0.1, T (fish) = < 0.01.
[3]%F = % frequency in total sample.
[4]ND = not detected after saponification.
[5]Fish sampled were as follows: Northern Pike (*Esox lucius*), Sauger (*Stizostedian canadense*), Walleye (*S. vitreum*), Yellow Perch (*Perca flavescens*), Black Bullhead (*Ictalurus melas*), Common Whitefish (*Coregonus clupeaformis*), White Sucker (*Catostomus commersoni*), and various minnows (Brook Stickleback, *Eucalia inconstans* and Shiners, *Nototropis* sp.). Probably due to the general low levels reported here in relation to the sensitivity of our analytical techniques, there were no apparent differences between the residues of the various species of fish. There were no differences between fish of the same species from lake to lake, probably for the same reasons.
[6]In 87% of the fish extracts, estimated levels of PCB were below 0.1 ppm (trace amounts in PCB estimates).

Manitoba and the other from Suggi Lake, Saskatchewan. The lowest cormorant egg residues of *p,p'*-DDE (1.4 ppm) were from Upper Souris, North Dakota and the lowest for pelicans (0.6 to 0.7 ppm) were from Dog Lake, Manitoba and Chase Lake, North Dakota. The lowest estimated PCB residues for pelicans were trace amounts found in egg pools from Chase Lake, North Dakota, and Dog and Pelican lakes, Manitoba. Plots of frequency distributions of the total residues suggested normal distributions, except for some slight skewness in the cormorants due to the single pool from Lake DuBay, Wisconsin.

The residues seem low enough to cause no alarm from an acute-toxicity point of view. As a source of food for fish-eating birds, the fish contained levels which were far below those required to induce poisoning in White Pelicans (J. O. Keith 1964) and in Bald Eagles, *Haliaeetus leucocephalus* (Stickel et al. 1966).

There were no significant residue differences between "live" and dead eggs of either species (*t*-test), as well as between their moisture percentages. Surviving Herring Gull (*Larus argentatus*) eggs have been shown to contain much higher levels (J. A. Keith 1966); and levels of chlorinated hydrocarbons that average above those we found in all pelicans and most cormorants were not believed to prevent the hatching of Bald Eagle eggs (Stickel et al. 1966). Extremely high levels in the yolks of Pheasant (*Phasianus colchicus*) eggs apparently did not affect their hatchabilities in incubators (Azevedo et al. 1965). In domestic chickens, Weihe (1967) showed that dietary levels as high as 200 ppm DDT only slightly reduced chick survival. Maximum yolk residues resulting from this diet were 300 ppm DDT and 80 ppm DDE.

Interspecific Differences

We estimated the 1965 dates of earliest egg-laying for each colony and for each species by backdating from the oldest young observed at the colony. Long-term arrival dates were estimated from the following sources: Bent (1922), Lewis (1929), Mendall (1936), and personal communications with refuge personnel. Apparently, pelicans arrive early on the breeding grounds (mean for five colonies = 19 April) and thus spend more time there before egg-laying (20 to 39 days) than cormorants (3 to 20 days), (95% C.L.). Cormorants arrive later (mean for seven general geographic areas = 3 May). Since pelicans probably winter farther south, they must have a more rapid migration than cormorants, or start north sooner. R. B. Klopman (*personal communication*) has observed pelicans arriving during cold and snowy weather at Dog Lake, and J. C. Bartonek (*personal communication*) has seen them on the ice at Pelican Lake. They are reported to arrive at Lake Yellowstone, Wyoming, very often while the lake is still frozen over (Diem and Condon 1967). Pelicans from more southern and western regions may not be under such "stresses," although they have been observed subject to early-season cold weather upon arrival at Nevada and California breeding grounds (J. O. Keith, *personal communication*). Cormorants, on the other hand, are known to migrate leisurely and usually do not arrive until the ice is out (Lewis 1929), although they generally winter farther north than pelicans. Interior cormorants most likely winter on the Gulf Coast and southern Mississippi River

(Lewis 1929:5-14) and Rio Grande valleys (Palmer 1962:367). White Pelicans from the interior most likely winter on the Gulf Coast and more commonly farther south into Mexico (Palmer 1962:331 and Ann Gammell, *personal communication*).

The studies of Wesley et al. (1965) and Stadelman et al. (1965) in demonstrating the diminution of fat and egg residues with a "clean" diet, however, suggest that the length of time spent in relatively uncontaminated areas might be a possible bias concerning the dates on which the cormorant and pelican eggs were laid in relation to the time they had already spent on the breeding grounds. There were no apparent differences in the percentages of egg fat (pelican = 4.42 ± 0.32%, cormorant = 4.26 ± 0.34%; 95% C.L.). There were no intraspecific relationships among the following factors and residues of DDE, PCB, or Dieldrin: (1) number of days between mean colony egg-laying and laying of the samples we took, and (2) the number of days the birds were on the breeding grounds before laying the sample we took.

Lamb et al. (1967) suggested that egg-laying is a large factor in the ability of a female pheasant to excrete Dieldrin, and Hunt et al. (in press, 1969) suggested a similar phenomenon with DDT. Decreasing amounts of Dieldrin were present in the eggs after cessation of Dieldrin in the diet (it was still present in the eggs after 14 days). Other studies with various insecticides have shown that residues are deposited in the eggs for long periods of time following termination of experimental treatments (Ware and Naber 1961—Lindane, Azevedo et al. 1965—DDT, and Stadelman et al. 1965—Dieldrin). DDT-residue accumulation in the eggs and fat of domestic poultry and pheasants has been shown to be related to dietary levels (Draper et al. 1952; Azevedo et al., 1965; Hunt et al., in press, 1969). Ratio differences of DDE over estimated PCB show they are greater in pelicans (2.9:1) than in cormorants (1.3:1) suggesting that, if local food was of prime importance, ratios in eggs would be similar. There was no evidence of different contamination levels of food between pelicans and cormorants at the time of sampling as suggested by (1) lack of marked residue-level differences between all species of fish sampled (Table 3), and (2) the observations at many of the feeding areas of both species feeding on, and even competing for, the same abundant food sources. Possible differences in residue-storage physiology between pelicans and cormorants on similar diets remain unknown. Resident species, representing different food-web levels, in the Gulf of California have been shown (Risebrough et al. 1968*b*) to have a characteristic DDE/PCB ratio. Migratory species, which breed in the area, but winter elsewhere, had different DDE/PCB ratios. Although egg residue levels are ultimately related to dietary levels, they probably represent stored residues rather than direct, local dietary influence in the two migratory species we have studied here. Since there were no relationships between time of egg-collecting or laying and the amounts of residues present, and since it has already been suggested that egg residues are often acquired prior to arrival on the breeding grounds (Sheldon et al. 1963, Henriksson et al. 1966, Anderson 1967, and others) we conclude that the major

TABLE 4. — Simple correlations between various egg-shell measurements of cormorants and pelicans and their various detected residues in ppm wet weight in individual pools

Species Grouping	No.	Measurement[1]	Correlation Coefficients: p, p′-DDE	Est. PCB	p, p′-TDE	p, p′-DDT
Cormorant:						
First nesters	29	WT	−.560**	−.463*	−.058	.203
		TH	−.797***	−.430*	.079	−.095
		T1	−.523**	−.347+	−.015	.221
		T2	−.527**	−.393*	.002	.201
Renests	6	WT	−.587	−.855*	ND	ND
		TH	−.441	−.395	ND	ND
		T1	−.706+	−.956**	ND	ND
		T2	−.648	−.892*	ND	ND
All nests	35	WT	−.562***	−.478**	−.086	.103
		TH	−.753***	−.449**	.036	−.142
		T1	−.547***	−.385*	−.045	.139
		T2	−.544***	−.424*	−.029	.128
Pelican:						
First nests	16	WT	−.432+	.046	−.468+	.235
		TH	−.445+	−.037	−.335	.329
		T1	−.550*	−.129	−.527*	−.058
		T2	−.521*	.089	−.548*	.115
All nests	20	WT	−.360	.094	−.392+	.250
		TH	−.436+	.059	−.320	.317
		T1	−.420+	.010	−.417+	.022
		T2	−.496*	.118	−.515*	.133

+$P \leqq 0.07$
*$P < 0.05$
**$P < 0.01$
***$P < 0.001$
[1]WT = shell weight, including membranes.
TH = shell thickness, including membranes.
T1 = shell weight/egg volume.
T2 = shell weight/(length × breadth), Ratcliffe (1967).
ND = not detected at the levels of sensitivity used.

interspecific differences between the egg residues in pelicans and cormorants are probably due to dissimilar nonbreeding-area exposures.

Significance of Residues

RELATIONSHIPS BETWEEN RESIDUES AND EGGSHELL DEPOSITION. Initially, we computed correlation coefficients, relating four eggshell measurements to the residue contents of each egg on both a total-micrograms-present basis and a ppm-wet-weight basis (Table 4). The correlations must be considered in relation to the amounts of residues present and their frequencies in our samples (Table 3). The residues should also be considered as an index to the concentrations of CH's in the female, not as the direct cause of shell changes. Both bases of comparison (micrograms *vs.* ppm) were in close agreement, but

TABLE 5. — Thickness of pelican and cormorant eggs from 1965 compared to pre-1940 museum specimens from the same general areas[1]

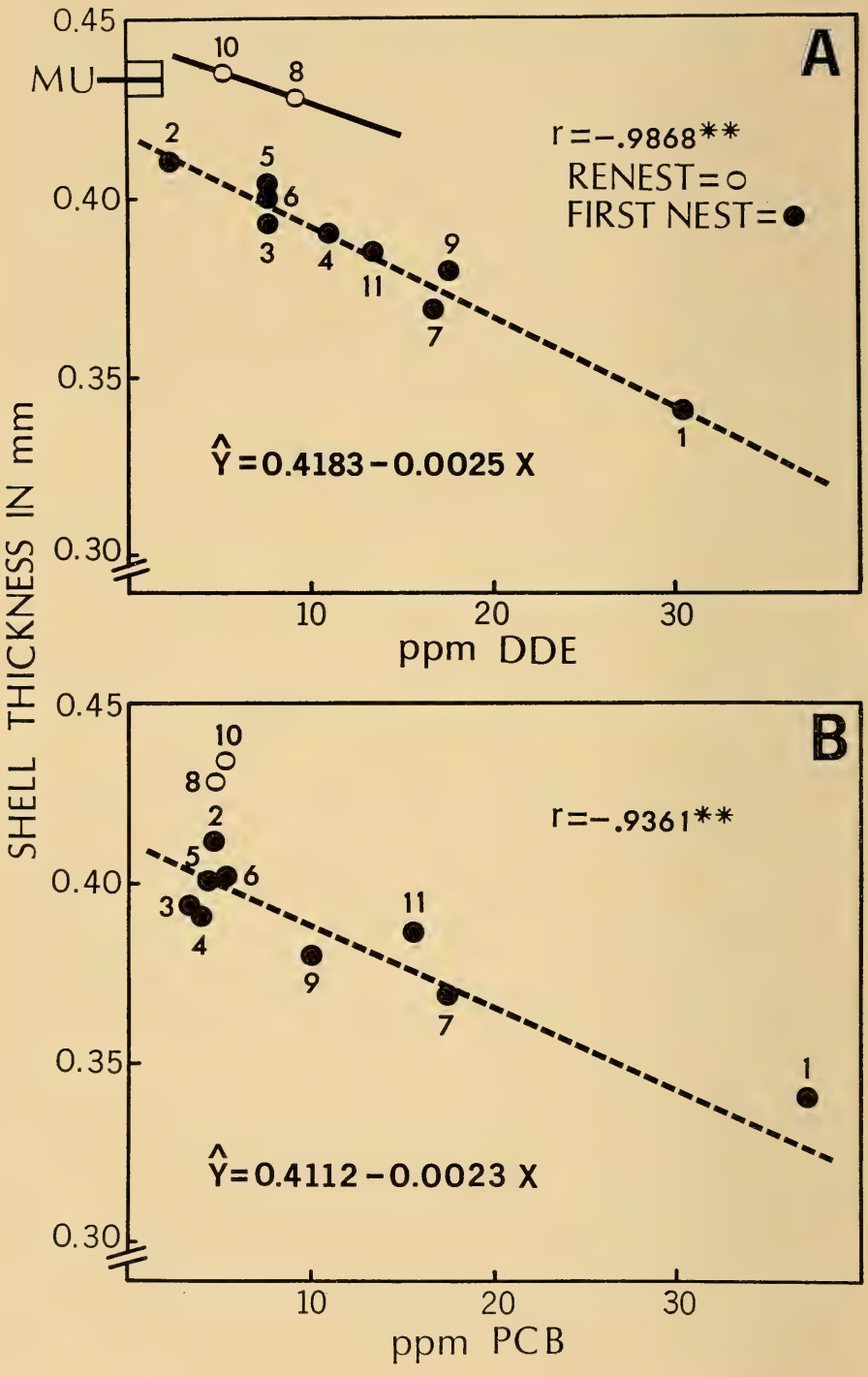
Species	Period	No.	Mean (mm) Thickness	95% C.L.	% Change
Pelican[2]	pre-1940	58	0.686	0.673–0.699	—
Pelican	1965	19	0.655	0.643–0.667	−4.5%
Cormorant[3]	pre-1940	100	0.434	0.429–0.439	—
Cormorant	1965	35	0.398	0.386–0.410	−8.3%

[1]These eggs were measured and obtained as described in Hickey and Anderson (1968); samples for the pre-1940 eggs were randomly selected from a larger pool of data.
[2]These means represent eggs taken in Alta., Sask., Man., N.D., Mont., and N.W.T. by egg-collectors.
[3]These means represent eggs taken as above in Alta., Sask., Man., Ont., N.D., Minn., and Mich.

we chose here to present the ppm-based data because most pesticide data in the literature have in the past been presented on this basis. Had we used addled eggs in our samples (thus likely desiccated), the calculations could only have been validly performed on the microgram basis.

The correlation coefficients suggest that in cormorants, *p,p'*-DDE and PCB's were closely related to changes in our indices of eggshell weight and thickness, as well as the actual measurements (Table 4). The residues of *p,p'*-DDT and *p,p'*-TDE were not present in sufficient quantity and frequency in the eggs of interior cormorants to be of prime importance in eggshell changes. The correlation between DDE and PCB in cormorants only was highly significant ($r = 0.5422$ $P < 0.001$), suggesting similar contamination patterns for these two compounds in that species. Both would naturally, then, correlate to shell changes, even if only one were having an effect. The stronger relationship of *p,p'*-DDE to eggshell changes in first-nest cormorants and the correlation of *p,p'*-DDE but not PCB's to eggshell changes in pelicans attests to the importance of that compound. The potential importance of PCB's is suggested, however, by their increased relationship to eggshell changes in renesting cormorants (Table 4). Further research is needed, however, before PCB's can be definitely tied to shell changes.

Regressions of shell thickness on both DDE and PCB's on a colony-basis (the ecological unit related to population changes) (Figure 3) show the importance of DDE and the possible importance of PCB's in predicting the magnitudes of shell change each population might be subject to ($P < 0.001$ for DDE, $P < 0.01$ for PCB's). Renests (Figure 3) show a tendency for eggshell "recovery" in cormorants in relations to both DDE and PCB's. The slopes are nearly equal, however (Figure 3*a*). Ludwig and Tomoff (1966) reported a higher nesting success in renesting Herring Gulls nesting at Grand Traverse Bay, Lake Michigan. That population had been subject to severe egg losses due to breakage and associated phenomenon in first nests.


A
0.45
MU
0.40
0.35
0.30
10
8
2
5
6
3
4
11
9
7
1
r=-.9868**
RENEST=○
FIRST NEST=●
Ŷ=0.4183-0.0025 X
10
20
30
ppm DDE
SHELL THICKNESS IN mm
B
0.45
0.40
0.35
0.30
10
8
2
5
6
3
4
11
9
7
1
r=-.9361**
Ŷ=0.4112-0.0023 X
10
20
30
ppm PCB

In pelicans, where all residues were present in much lower amounts than in cormorants (Table 3), *p,p'*-DDE and *p,p'*-TDE showed significant or nearly significant relationships with nearly all the eggshell parameters tested (Table 4). Unfortunately, only four first-nest colonies were represented, not enough points for a valid, predictive regression on the colony basis as above with cormorants. A regression of shell thickness and residues of DDE + TDE on an individual-pool basis (Figure 4) is nonetheless significant ($P < 0.05$).

It appears that in both species, measurable declines in shell weight and thickness can be related to the lowest residues of *p,p'*-DDE and PCB. Within the limits of our residue-detection ability, there does not appear to be a minimum effective level concerning changes in eggshell. Low levels of residues in the diet (Table 3) and the tendency for shell thickness recovery in renests suggests that breeding-season depletion of fat reserves is less important than the direct dietary effects on eggshell deposition in the two species we studied. It follows that residue-thickness relationships need not always relate, but may depend on the particular residue-exposure, ecological situation to which a given breeding bird (or group of breeding birds) is exposed prior to and during egg and shell formation.

Since the percentages of fat in cormorant eggs were essentially the same in first nests (4.24%) as in renests (4.37%) their residue differences might be explained by postulating some dilution in the fat of previously stored residues. Residues on a fat basis suggested this (262 ppm for first nests and 166 ppm for renests. The residues in the eggs of renests were lower, but not significantly so (Table 3), probably due to limited degrees of freedom in the small sample of renests. The differences in amount of residues in the fat of the eggs, then, could account for the lower mean residues in renests, but suggest that previously stored residues are still important in egg deposition.

To further test for changes in shell thickness, we independently compared our 1965 eggs with museum specimens from the same geographical areas, but from the pre-DDT period. The comparisons (Table 5) showed small, but significant ($P < 0.05$) changes in shell thicknesses of both pelicans and cormorants.

POPULATION STATUS. The populations of White Pelicans we studied seem stationary (Anderson 1967), except where they are locally subject to disturbance and molestation. Lies and Behle (1966) concluded that the White Pelican

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FIGURE 3. Relationships between DDE residues (A), estimated PCB residues (B), and shell thickness in Double-crested Cormorants, plotted on a colony-basis. Individual points are numbered in accordance with Figure 1. Open circles represent renest colonies (the original colony of the season was destroyed or disturbed away from the first-nest site, therefore, phenologically behind other colonies from the same general latitude and longitude) and closed circles represent first-nest colonies. "MU" in the upper figure represents the museum mean thickness (Table 5), bounded by 95% Confidence Limits. Figure 3A, $P<0.001$; Figure 3B, $P<0.01$. The line-of-fit for renests in A. was fitted by eye but clearly resembled the calculated regression based on individual pools. A line-of-fit for renests in B., though significant on an individual-pool basis, was not obvious on a colony basis.

has declined since the early 1900's due to its sensitivity to disturbances during breeding. The major reason for the long-term decline of the White Pelican seems to be related to increasing infringement upon its breeding habitat by advancing "civilization." In the United States, the refuge system has probably been responsible for the maintenance of essentially stable numbers. In Canada, the species is still threatened by disturbances of the nesting colonies by fishermen (Carson 1966), and by tourists and other factors (Houston 1962). One of the largest breeding colonies in Canada (at Primrose Lake, Saskatchewan) may be threatened by a bombing range.

The Lake DuBay, Wisconsin, breeding population of cormorants showing a 25% decline in shell thickness (Figure 3) has recently decreased to nearly zero (Anderson and Hamerstrom 1967). Since the report of Anderson and Hamerstrom (1967), these birds (about 15 adults in the area in 1967) occupied only one nest in 1967, which failed (C. R. Sindelar Jr., *personal communication*). J.J.H. and D.W.A. were unable to find any occupied nests on 31 May 1968 at Lake DuBay, although about 10 adults frequented the traditional nesting site, where a reasonably stationary population of Great Blue Herons (*Ardea herodias*) persists. A large flock of cormorants was observed in the rookery area on 23 June 1968 (Frances Hamerstrom, *personal communication*). Forty-two dark adults and eight light-coloured yearlings were seen. This flocking behavior is indeed unusual, during a period when the birds should have been exhibiting reproductive, not migratory, behavior. Traditionally, young of nearly banding age would be found at the colony by late June. Late nesting has characterized the cormorant rookery at Lake DuBay in recent years (Frances Hamerstrom, *personal communication*). In 1968, one cormorant nest was found by F. H. from which three abandoned eggs were taken. These eggs averaged 16 ppm *p,p'*-DDE, 46 ppm estimated PCB, and 1.5 ppm each of Dieldrin and HE. The mean thickness for these three eggs was 0.37 mm, predictable in Figure 3*a*.

Agassiz cormorants were known to be stationary in 1965, compared to the early 1940's (J. W. Ellis, *personal communication*). Upper Souris, Salyer, and Chase Lake cormorants (see Figure 1 for these locations) seemed stationary or not seriously declining in 1965 (Anderson 1967), although the Salyer colony seemed to be holding its numbers at a much lower level compared to the mid-1940's (M. C. Hammond, *personal communication*). Deterioration of nesting habitat and predation might have been important factors in the decline of the Salyer colony. Lake Garrison cormorants had increased up to the 1960's (G. Enyeart, *personal communication*) due to an opening of new habitat (flooded trees) and creation of abundant food supplies (Anderson 1967), although somewhat affected by shell changes in 1965 (Figure 3). The long-term status of the Canadian cormorant colonies we studied remains generally unknown.

In general, it appears that the status of a given colony can be related to the residues and shell thickness of the eggs from that colony, especially in areas such as Lake DuBay, where changes have been rather marked. Other ecological factors undoubtedly complicate the situations and probably modify them.

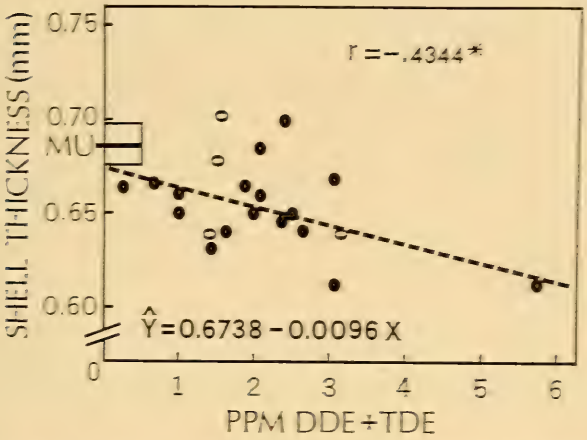

FIGURE 4. Relationship between DDE + TDE and eggshell thickness in White Pelicans, as described in Figure 3, except that these points represent individual pools rather than colonies. $P<0.05$.

DECLINING POPULATIONS, REPRODUCTIVE SUCCESS, AND SUBLETHAL EFFECTS OF CHLORINATED HYDROCARBONS. Cramp et al. (1964) hypothesized that declines of raptors in Great Britain were due to "sub-lethal effects in reducing fertility." Their ranges of residue levels in four raptors were from 1.8 to 12.1 ppm. Lockie and Ratcliffe (1964) reported in great detail on Golden Eagle (*Aquila chrysaëtos*) egg breakage in Scotland. Egg residues on the order of 0.25 to 10.29 ppm were detected. Eyries with histories of 1.44 to 6.90 ppm showed definite egg breakage, whereas eyries with residues of 1.1 or less bred successfully or resulted in occasionally addled, but not broken eggs. A certain percentage of addled eggs was considered normal, as usually these eagles lay two eggs but raise only one young. These authors concluded that toxic chemicals were to blame as affecting behavior of adults. Lockie (1967) later stressing Dieldrin residues alone stated: ". . . the critical level at which behavior became upset as evidenced by egg-breaking, was no higher than 1 ppm (part per million) of Dieldrin in the egg contents. However, this is a very rough figure since other chemicals, for example DDE (a metabolite of DDT), BHC, and Heptachlor were present in varying amounts . . ." Wurster and Wingate (1968) associated residues of 3.61 to 11.04 ppm in the eggs of Bermuda Petrels (*Pterodroma cahow*) with their declining reproductive success. Ratcliffe (1967*a*) reported on egg breakage in British Peregrines (*Falco peregrinus*) and on residues associated with unsuccessful eyries (17.4 mean ppm CH residues) and eyries with improved success since 1963 (12.7 ppm). The general Peregrine population in Britain has not shown recovery, however, and Ratcliffe concludes that persistent organo-chlorine pesticides have been the causal factor in the decline and failure of recovery of these birds. In a pioneering study, Ratcliffe (1967*b*) showed that three declining species of British raptors (Peregrines, Golden Eagles, and European Sparrow Hawks [*Ac-*

cipiter nisus]) had been laying thin-shelled eggs. This phenomenon was related to an environmental change which had occurred in 1947. Hickey and Anderson (1968) subsequently showed that some North American populations of Peregrine Falcons began to lay thin-shelled eggs in 1947, prior to their extirpation over large areas of the United States and southern Canada (summarized in Hickey 1969). Declining populations of Bald Eagles, Ospreys (*Pandion haliaetus*), and Peregrines displayed this shell-thinning phenomenon, but stationary populations of Ospreys, Red-tailed Hawks (*Buteo jamaicensis*), Great Horned Owls (*Bubo virginianus*), and Golden Eagles showed no evidence of shell-thinning (Hickey and Anderson 1968).

PHYSIOLOGICAL EFFECTS OF CHLORINATED HYDROCARBONS RELATING TO EGGSHELL FORMATION. The data presented in this paper suggest that DDE has a greater effect on shell thickness than PCB. The limited work so far carried out concerning the induction of steroid hydroxylating enzymes in birds by PCB and Dieldrin (Peakall 1967, Risebrough et al. 1968*b*) indicate, however, that both PCB and Dieldrin are more potent enzyme inducers than *p,p'*-DDE or *p,p'*-DDT. Elevated levels of steroid metabolism resulting from the induction of nonspecific oxidase enzymes in the microsomal fraction could affect calcium metabolism in several ways (Ratcliffe 1967*b*; Peakall 1967; Risebrough et al. 1968*b*; Wurster, in press, 1969). Estrogen and androgen are essential for the deposition of medullary bone, which is a major source of eggshell calcium (reviewed by Simkiss 1967:160-185). Vitamin D is essential for calcium absorption from the small intestine (reviewed by Simkiss 1967:62-71). The active form of Vitamin D is a derivative of Vitamin D_3 and is hydroxylated at the 25 position (Blunt et al. 1968). Nonspecific hydroxylation of the Vitamin D_3 molecule at different positions by the induced enzymes might therefore create an artificial Vitamin D deficiency.

Neither estrogen nor Vitamin D degradation, however, can adequately explain the absence of a no-effect range of concentrations of DDE upon shell thickness and the observed linear relationships between DDE concentration and shell thickness. This relationship, moreover, is linear to zero concentration of DDE and the shell thickness at zero concentration is equivalent to, or slightly less, than the shell thickness of eggs collected before 1940 (Figures 3 and 4). In addition to the data here presented for White Pelicans and Double-crested Cormorants, a linear relationship has also been found between DDE concentrations in the eggs and the thickness of the shells from Herring Gulls ($P < 0.001$) (Hickey and Anderson 1968). Feedback mechanisms would be expected to maintain essential estrogen levels at lower DDE concentrations. Similarly, gross abnormalities of Vitamin D metabolism would be expected only when induced steroid hydroxylase activities are significantly higher than normal, especially in fish-eating birds which receive adequate Vitamin D in their diets.

The enzyme carbonic anhydase is found in the cells of the shell gland where it catalyses the formation of the carbonate ions which combine with calcium to form the calcium carbonate of the eggshell (Common 1941,

Gutowska and Mitchell 1945, Bernstein et al. 1968). Inhibition of this enzyme by sulfanilamide and other unsubstituted sulfonamides such as acetazolamide results in the production of thin-shelled eggs (Gutowska and Mitchell 1945, Benesch et al. 1945). Carbonic anhydrase inhibition in the shell gland by acetazolamide has been correlated with decreases in eggshell weight (Bernstein et al. 1968). Microgram amounts of DDT also inhibit carbonic anhydrase prepared from bovine erythrocytes (Keller 1952, 1963). Preparations of the mammalian enzyme are also inhibited *in vitro* by *p,p'*-DDE at physiological concentrations (R. W. Risebrough, in preparation). Inhibition *in vivo* of carbonic anhydrase in birds by DDE could therefore account for the linear relationships plotted in Figures 3 and 4. It would also explain how the effect of DDE upon shell changes could be greater than the effects of other chlorinated hydrocarbons which are more potent enzyme inducers.

Concluding Comments

The present study was largely accomplished before the nature of PCB interference in the determination of the DDT-compounds was known. The initial conclusions, however, were not greatly changed when corrections were made for this interference. DDE appears to be the environmental pollutant most responsible for the thin eggshell phenomenon. The effects upon avian reproduction of the polychlorinated biphenyls and other environmental pollutants, of elevated levels of steroid metabolism, of possible abnormal vitamin metabolism caused by environmental pollutants, and of the possible inhibition of carbonic anhydrase and other enzyme systems remain to be determined. We hope this will be accomplished before the fish-eating birds have disappeared.

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VEGETATION OF A PRAIRIE NEAR WINNIPEG, MANITOBA

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Introduction

The Red River prairie of Manitoba, after less than 100 years of settlement, has largely disappeared. Recent actions by the International Biological Program, Manitoba Committee for the Conservation of Terrestrial Ecosystems, have emphasized that true prairie vegetation in the southern part of the Province has all but vanished. The efforts of this Committee, during the summer of 1968, were directed toward recognizing the remaining fragments of this once extensive grassland and initiation of appropriate measures to insure their preservation.

The complete loss of true prairie as a natural vegetation type in Manitoba would be incalculable for as Aldo Leopold (1941) stated, "each biotic province needs its own wilderness for comparative studies of used and unused land." Wilderness, then, became for Leopold the most perfect norm to a science of land health. The second norm which Leopold described was one in which the land physiology has remained [stable] despite centuries of human use.

It is apparent that true prairie has not been defended for one hundred years and its lack of resistance to changing land use precludes its being a wilderness as described by Leopold. For the most part, only fragments of prairie are left, or have redeveloped, on disturbed soils. As physiognomic types, they bring us close to both wilderness and centuries of land use.

In our presentation we describe one small area of grassland in the true prairie region of Manitoba and give suggestions for its management with the hope that the loss of a last remnant of a once widespread landscape type will be recognized to be as tragic as extinction of an animal or plant species.

Location, History, and Physical Setting

The Beaudry Prairie (Fig. 1) lies on the south side of Route 241, west of Headingley. It is composed of two adjoining rights-of-way owned by Canadian National Railways and Manitoba Highways. These rights-of-way extend one mile from surveyed road registered plan number 3801 (Parish lots 7 and 8, St. Francis Xavier) west to the junction of provincial routes 241 and 424 (Parish Lots 22 and 23). The combined width of the two rights-of-way is approximately 110 feet. The name 'Beaudry' has been derived from the nearest railway siding (Fig. 1).

The railroad was established here in 1908 and put into use immediately, as part of the Grand Trunk, from Winnipeg to Portage la Prairie. Regular use was discontinued in 1965, and at present the track is used five times per year from Winnipeg to Cabot. Management techniques on the railroad

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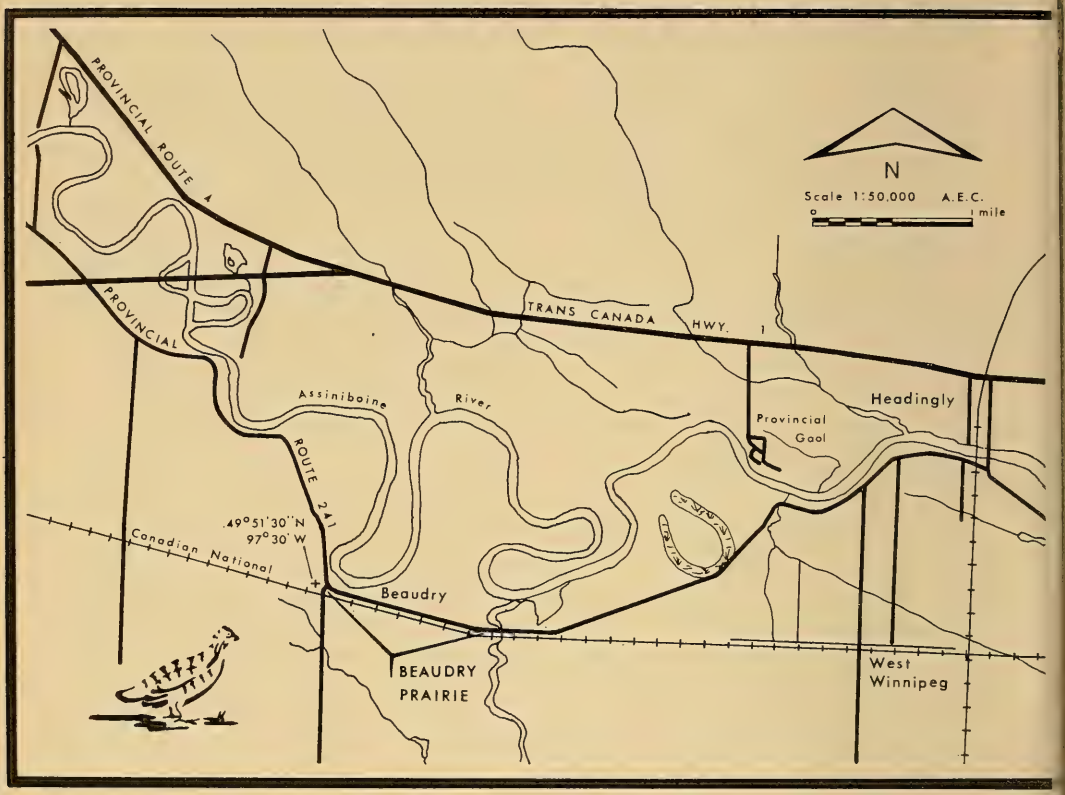

FIGURE 1. Map illustrating location of Beaudry Prairie in relation to major landmarks. The topographic base map is Winnipeg, Manitoba, 62 H/14 West Half, First Edition, 1954, available from the Department of Mines and Technical Surveys, Ottawa.

TABLE 1. — Species Composition in the *Andropogon gerardi* Type Prairie

Species	Mean Foliage Cover	% Frequency	Species	Mean Foliage Cover	% Frequency
Andropogon gerardi	33	100	*Steironema ciliatum*	1	29
Galium sepentrionale	35	100	*Fragaria virginiana*	1	29
Thalictrum venulsoum	6	100	*Zizia aptera*	1	14
Spartina pectinata	6	86	*Lathyrus ochroleucus*	1	14
Astragalus goniatus	6	43	*Salix petiolaris*	<1	43
Anemone canadensis	5	71	*Comandra richardsiana*	<1	29
Symphoricarpos occidentalis	4	86	*Geranium bicknellii*	<1	29
Amelanchier alnifolia	4	71	*Heliopsis helianthoides* var. *scrabra*	<1	14
Rosa acicularis	3	100	*Cirsium flodmanii*	<1	14
Helianthus laetiflorus	3	71	*Heuchera richardsonii*	<1	14
Artemisia ludoviciana	3	71	*Anemone cylindrica*	<1	14
Helianthus maximiliani	3	57	*Sisyrinchium montanum*	<1	14
Solidago missouriensis	1	57	*Crepis tectorum*	<1	14
Panicum leibergii	1	57	*Sonchus uliginosus*	<1	14
Lathyrus palustris	1	43	*Spiraea alba*	<1	14
Vicia americana	1	43	*Populus balsamifera* X *P. deltoides*	<1	14
Glycyrrhiza lepidota	1	29			

right-of-way have included blanket spraying of Atlacide[1], a soil sterilant, during the last two weeks of June to a distance of 8 feet from the center of the track. Annual burning of this right-of-way was customary in the autumn prior to 1965. Management of the highway right-of-way has been by a single mowing each midsummer. Fires set by the railway undoubtedly have spread to the roadside. During dry spring seasons it is probable that wild-fires, near the end of March, have been frequent.

The soil of the Beaudry Prairie is a lacustrine fine clay sediment of the Red River Association. Although it apparently has been disturbed by construction activities in the past, this soil exhibits characteristics of a variant of the St. Norbert clay. (Ehrlich et al. 1963). This is a woodland soil type

TABLE 2. — Species Composition in the *Stipa spartea — Andropogon gerardi* Type Prairie

Species	Mean Foliage Cover	% Frequency
Stipa spartea	50	100
Andropogon gerardi	19	50
Galium septentrionale	19	100
Astragalus goniatus	11	100
Rosa acicularis	5	100
Artemisia ludoviciana	5	100
Amelanchier alnifolia	5	67
Helianthus laetiflorus	4	67
Symphoricarpos occidentalis	3	50
Spartina pectinata	2	83
Thalictrum venulosum	2	67
Panicum leibergii	2	50
Lithospermum canescens	1	50
Monarda fistulosa	1	34
Lathyrus ochroleucus	1	17
Glycyrrhiza lepidota	<1	50
Solidago rigida	<1	34
Comandra richardsiana	<1	34
Geranium bicknellii	<1	34
Anemone cylindrica	<1	17
Asclepias ovalifolia	<1	17

that characteristically supports bur oak (*Quercus macrocarpa*). In the Beaudry Prairie seedlings of bur oak are now present.

METHODS

The site was first visited on August 14, 1967, and subsequent plant collections were made on June 27, July 4, July 24 and August 1, 1968. Voucher specimens have been deposited in the Herbarium of the Canada Department of Agriculture, Ottawa, Ontario. Nomenclature follows Scoggan (1957) except *Phragmites australis* (Clayton, 1968).

[1]'Atlacide', 58% Sodium Chlorate; Chipman Chemical Company, P.O. Box 2009, Murchison Drive, New Brunswick, N.J.

FIGURE 2. Big bluestem (*Andropogon gerardi*) cover type found on moist parts of the site. Wolfberry (*Symphoricarpos occidentalis*) is the principal species along the embankment at the top of the land form. August 15, 1968.

The cover of two of the most representative prairie vegetation types was sampled using 0.5 x 2 m quadrats on July 24, 1968. In each type 7 quadrats appeared, by inspection, to give an adequate representation of the vegetation. We have used the designation "foliage cover" to indicate projection of above ground parts.

FLORA AND VEGETATION

The flora of the Beaudry Prairie (Table 3) was found to be composed of 108 species of flowering plants. One moss was also recorded. Of these, only 17 (15%) are species not native to the region. Although not all species were found in both sampled stands (Tables 1 and 2) we have included a complete floristic list (Table 3) for comparisons in the future.

The big bluestem type (Table 1, Fig. 2) was the most extensive of the two types. This was found on more mesic sites (Weaver, 1954) in the area. In the Beaudry Prairie *Andropogon gerardi*, the aspect dominant was mixed with a small amount of cordgrass (*Spartina pectinata*). A carpet of northern bedstraw (*Galium septentrionale*), with occasional plants of meadow-rue (*Thalictrum venulosum*) was found beneath the foliage of these grasses. A few individuals of milk-vetch (*Astragalus goniatus*) also were present in this mat. Two species of sunflower (*Helianthus laetiflorus* and *H. maximiliani*) and the conspicuous wormwood (*Artemisia ludoviciana*) comprised the major forb cover. Wolfberry (*Symphoricarpos occidentalis*) juneberry (*Amelanchier alnifolia*), and wild rose (*Rosa acicularis*) were the most frequent woody plants. Most of these shrubs had a stunted appearance.

FIGURE 3. Porcupine grass (*Stipa spartea*) – big bluestem (*Andropogon gerardi*) cover type found on driest parts of the site. *Stipa* is shown by the light colored fruiting culms, while *Andropogon* is represented by the darker culms at the left and upper centre. The shrub in the lower center is juneberry (*Amelanchier alnifolia*). August 1, 1968.

The porcupine grass – big bluestem type (Table 2, Fig. 3) was found on slightly more elevated and drier sites in the prairie. *Stipa spartea* dominated this cover type and contributed approximately half the total foliage cover. Slight differences in drainage contributed to a more xeric environment with a decrease in cordgrass (*Spartina pectinata*), a presence of puccoon (*Lithospermum canescens*), and a slight increase in panic grass (*Panicum leibergii*). Shrubs were again present at uncommon levels and exhibited poor vigor. Twenty-one species, in total, appeared in our sample of this type compared with 33 species in the big bluestem cover type.

MANAGEMENT

Virtual abandonment of the railway in 1965, with elimination of fire as a control to prevent snow from drifting, has allowed these prairie types to become invaded by woody species. Further increases in *Symphoricarpos occidentalis* and *Quercus macrocarpa* along with non-prairie components can be expected unless fire or mowing is employed as a tool in management.

Pelton (1953) suggested that annual or very frequent fires are probably detrimental to *Symphoricarpos*. Kucera, Ehrenreich and Brown (1963) concluded the fires set in the spring, when fuels are dry and temperatures are warm, would kill invading trees in Missouri prairie. It was suspected that if the trees had begun physiological activity at this time, greater overall damage would result. Kucera and Koelling (1964) noted, however, that annual

burning would favor grasses to the exclusion of other prairie components, and that biennial burning would reduce densities of forbs. Since the main objective of management on the Beaudry Prairie is to maintain a rich species composition of both grasses and forbs, we suggest that burning should be initiated in the spring. Ehrenreich and Aikman (1963) have shown that occasional spring burning of native prairie in Iowa would not harm the vegetation and may increase the seed produced by native grasses over those of introduced grasses. Snow management objectives could be accomplished by mowing the vegetation at the end of the growing season after the plants have shed seeds, and when the ground is frozen. Subsequent burning, possibly on a three year cycle, should be delayed in order to allow an assessment of change in floristic composition and dominance patterns. The more aggressive trees and shrubs, in this period, could be eliminated with selectively applied herbicides.

Acknowledgements

We wish to thank officials of Canadian National Railways (Mr. L. H. B. Gooding) and Manitoba Highways (Mr. S. Goodbrandson) for their cooperation in preserving the prairie as an experimental area.

The site was first visited in company with Dr. R. W. Nero. Mr. C. B. Gill provided us with a partial list of the species on the site and Dr. C. D. Bird identified the moss species. Drs. Frank E. Egler, Roger Q. Landers, Jack McCormick and Robert P. McIntosh offered valuable criticism on the manuscript.

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TABLE 3. — Flora of the Beaudry Prairie

Species and Authority	Common Name	Abundance[1]
Bryaceae Musciae		
Bryum stenotrichum C. Müll.		o
Dicotyledonae		
Ranunculaceae		
Anemone canadensis L.	Anemone	In vegetation list
Anemone cylindrica Gray	Thimbleweed	In vegetation list
Ranunculus abortivus L.	Kidneyleaf-Buttercup	vr
Thalictrum venulosum Trel.	Meadow-Rue	In vegetation list
Saxifragaceae		
Heuchera richardsonii R. Br.	Alumroot	In vegetation list
Rosaceae		
Amelanchier alnifolia Nutt.	Juneberry	In vegetation list
Crataegus succulenta Link	Hawthorn	abs
Fragaria virginiana Duchesne	Strawberry	In vegetation list
Potentilla arguta Pursh	Tall Cinquefoil	vr
Potentilla norvegica L.	Cinquefoil	r
Prunus virginiana L.	Choke-cherry	vr
Rosa acicularis Lindl.	Rose	In vegetation list
Spiraea alba Du Roi	Meadow-Sweet	In vegetation list
Leguminosae		
Amorpha nana Nutt.	Fragrant False Indigo	vr
Astragalus canadensis L.	Milk-Vetch	o
Astragalus flexuosus Dougl.	Milk-Vetch	abs
Astragalus goniatus Nutt.	Milk-Vetch	In vegetation list
Glycyrrhiza lepidota (Nutt.) Pursh	Wild Licorice	In vegetation list
Lathyrus ochroleucus Hook.	Pale Vetchling	In vegetation list
Lathyrus palustris L.	Vetchling	In vegetation list
Lathyrus venosus Muhl. var. *intonsus* Butt. &. St. John	Vetchling	o
**Medicago sativa* L.	Alfalfa	abs
**Melilotus alba* Desr.	White Melilot	vr
**Melilotus officinalis* (L.) Lam.	Yellow Melilot	r
Petalostemum purpureum (Vent.) Rydb.	Prairie Clover	o
**Trifolium pratense* L.	Red Clover	abs
Vicia americana Muhl.	Vetch	In vegetation list
Fagaceae		
Quercus macrocarpa Michx.	Bur Oak	o
Aceraceae		
Acer negundo L.	Box-Elder	abs
Anacardiaceae		
Rhus radicans L. var. *rydbergii* (Small) Rehd.	Poison Ivy	vr
Geraniaceae		
Geranium bicknellii Britt.	Cranesbill	In vegetation list
Umbelliferae		
Sanicula marilandica L.	Sanicle	vr
Zizia aptera (Gray) Fern.		In vegetation list
Zizia aurea (L.) W. D. J. Koch	Golden Alexanders	r

TABLE 3. (*Continued*)

Species and Authority	Common Name	Abundance[1]
Santalaceae		
Comandra richardsiana Fern.	Bastard-Toadflax	In vegetation list
Caryophyllaceae		
**Silene cserei* Baumg.	Catchfly	abs
Polygonaceae		
**Rumex crispus* L.	Yellow Dock	abs
Cruciferae		
**Brassica kaber* (DC.) L.C. Wheeler	Charlock	abs
Descurainia pinnata (Walt.) Britt. var. *brachycarpa* (Richards.) Fern.	Tansy-Mustard	abs
Lepidium densiflorum Schrad.	Peppergrass	abs
Salicaceae		
Populus balsamifera L. X P. deltoides Marsh	Poplar hybrid	In vegetation list
Populus tremuloides Michx.	Aspen	r
Salix amygdaloides Anderss.	Peach-leaved Willow	r
Salix bebbiana Sarg.	Willow	r
Salix interior Rowlee	Sandbar-Willow	r
Salix lutea Nutt.	Yellow Willow	r
Salix petiolaris Sm.	Willow	In vegetation list
Primulaceae		
Steironema ciliatum (L.) Raf.	Fringed Loosestrife	In vegetation list
Gentianaceae		
Gentiana andrewsii Griseb.	Closed Gentian	o
Asclepiadaceae		
Asclepias ovalifolia Dcne.	Milkweed	In vegetation list
Convolvulaceae		
Convolvulus sepium L.	Hedge-Bindweed	abs
Boraginaceae		
Lithospermum canescens (Michx.) Lehm.	Puccoon	In vegetation list
Labiatae		
Mentha arvensis L. var. *villosa* (Benth.) Stewart	Mint	abs
Monarda fistulosa L.	Wild Bergamot	In vegetation list
Stachys palustris L. var. *pilosa* (Nutt.) Fern.	Woundwort	abs
Campanulaceae		
Campanula rotundifolia L.	Harebell	o
Rubiaceae		
Galium septentrionale R. & S.	Northern Bedstraw	In vegetation list
Caprifoliaceae		
Symphoricarpos occidentalis Hook.	Wolfberry	In vegetation list

TABLE 3. (*Continued*)

Species and Authority	Common Name	Abundance[1]
Compositae		
Achillea lanulosa Nutt.	Yarrow	r
Agoseris glauca (Nutt.) Greene		o
Ambrosia trifida L.	Great Ragweed	abs
**Artemisia absinthium* L.	Wormwood	abs
Artemisia ludoviciana Nutt.	Wormwood	In vegetation list
Aster laevis L.	Aster	o
Aster pansus (Blake) Cronq.	Aster	o
**Cirsium arvense* (L.) Scop.	Canada Thistle	abs
**Cirsium arvense* f. *albiflorum* (Rand & Redf.) Hoffm.		abs
Cirsium flodmanii (Rydb.) Arthur	Flodman's Thistle	In vegetation list
**Crepis tectorum* L.	Hawk's-beard	In vegetation list
Grindelia squarrosa (Pursh) Dunal	Curlycup-Gumweed	abs
Helianthus laetiflorus Pers.	Sunflower	In vegetation list
Helianthus maximiliani Schrad.	Sunflower	In vegetation list
Heliopsis helianthoides (L.) Sweet var. *scabra* (Dunal) Fern.	Ox-eye	In vegetation list
Hieracium umbellatum L.	Hawkweed	vr
Lactuca pulchella (Pursh) DC.	Lettuce	vr
Liatris ligulistylis (Nels.) K. Schum.	Blazing-star	o
Prenanthes racemosa Michx.	Rattlesnake-root	vr
Rudbeckia serotina Nutt.	Black-eyed Susan	o
Senecio pauperculus Michx.	Groundsel	r
Solidago canadensis L.	Goldenrod	vr
Solidago missouriensis Nutt.	Goldenrod	In vegetation list
Solidago rigida L.	Goldenrod	In vegetation list
**Sonchus uliginosus* Bieb.	Sow-Thistle	In vegetation list
**Taraxacum officinale* Weber	Common Dandelion	vr
Monocotyledonae		
Liliaceae		
Allium stellatum Fraser	Wild Onion	o
Smilacina stellata (L.) Desf.	False Solomon's-seal	vr
Iridaceae		
Sisyrinchium montanum Greene	Blue-eyed Grass	In vegetation list
Orchidaceae		
Cypripedium calceolus L. var. *parviflorum* (Salisb.) Fern.	Small Yellow Lady's-slipper	abs
Juncaceae		
Juncus balticus Willd. var. littoralis Engelm.	Rush	abs
Gramineae		
**Agropyron cristatum* (L.) Gaertn.	Crested Wheat-Grass	abs
Agropyron trachycaulum (Link) Malte	Wheat-Grass	o
Andropogon gerardi Vitman	Big Bluestem	In vegetation list
**Bromus inermis* Leyss.	Brome-Grass	abs
Festuca rubra L.	Fescue-Grass	vr
Hierochloë odorata (L.) Beauv.	Sweet Grass	vr
Hordeum jubatum L.	Squirrel-tail Grass	abs
Koeleria cristata (L.) Pers.	June Grass	o
Panicum leibergii (Vasey) Scribn.	Panic-Grass	In vegetation list
**Phleum pratense* L.	Timothy	abs

TABLE 3. (*Continued*)

Species and Authority	Common Name	Abundance[1]
Phragmites australis (Cav.) Trin. ex Steudel	Reed	abs
**Poa compressa* L.	Wiregrass	vr
Poa palustris L.	Fowl-meadow Grass	abs
Poa pratensis L.	Kentucky Bluegrass	vr
Spartina pectinata Link	Cord-Grass	In vegetation list
Stipa spartea Trin.	Porcupine-Grass	In vegetation list
Cyperaceae		
Carex brevior (Dew.) Mack.	Sedge	abs
Carex laeviconica Dew.	Sedge	abs
Carex lanuginosa Michx.	Sedge	abs

d — dominant
va — very abundant
a — abundant
f — frequent
o — occasional
r — rare
vr — very rare
abs — absent from prairie cover types but present along the rights-of-way
* — naturalized species. All others are native in the area.

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OBSERVATIONS OF WOLVES AT A RENDEZVOUS SITE IN ALGONQUIN PARK

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THIS PAPER describes the activities of four adult timber wolves (*Canis lupus lycaon L.*) and three pups observed for 16 days in August, 1962 in Algonquin Provincial Park, Ontario.

These observations, made as part of the Ontario Department of Lands and Forests' wolf research program directed by Dr. Pimlott, are of value as descriptive information on wolf behaviour in summer in forested regions is uncommon.

Contact was maintained with the wolves by broadcasting pre-recorded wolf howls from a portable record player, or by imitating wolf howls and listening for replies (Pimlott, 1960), and by direct observation. Observations were made in the open, often within sight of the wolves, at a distance of 500

feet. The wolves rarely paid any attention to the observers, however once, Pimlott was approached by a single wolf to within 75 feet.

The centre of activity of the pack, hereafter called a rendezvous site, encompassed approximately 80 acres one mile east of Annie Bay of Lake Opeongo, at the edge of a large clearing logged and burned 15 years previously. Before burning, black spruce (*Picea mariana*) had grown on lower sites, and red pine (*Pinus resinosa*), white pine (*Pinus strobus*), sugar maple (*Acer saccharum*) and yellow birch (*Betula lutea*) on better drained sites. Some red pine survived the cutting and fire, and aspen (*Populus tremuloides*) regeneration had begun in places. Principally, however, ground cover consisted of bracken fern (*Pteridium aquilinum*) and blueberry (*Vaccinium angustifolium*) interspersed with many burned stumps and logs. A bog with sedge, grass and ericaceous shrubs occupied one fifth of the rendezvous site.

The north edge of the burn, often frequented by the wolves, consisted of a stand of dense black spruce which occupied a wet *Sphagnum* site.

PACK AND INDIVIDUAL MOVEMENTS

The pack was originally located on the night of August 7 when it answered a recording of wolf pup howls played from a distance of one half a mile. Some wolves were heard or seen at the rendezvous site on all but two of the subsequent 16 days. No check was made on one of these days. On the other, a pack was heard about a mile away but its identity was uncertain as another pack was occasionally within hearing.

The wolves disappeared on August 24, and although a pack was heard a mile away on that date and on August 26, we were unable to establish its identity. The study terminated August 29 with no record of wolves returning to the rendezvous site.

The three pups formed the nucleus of the pack at the rendezvous site. Only once were they observed away from the site. On that occasion they howled from a location about one half mile away, whereupon an adult wolf ran off the burn towards them; it reappeared with them 20 minutes later. This was the only time we suspected that the pups were unattended by an adult wolf.

Four adults were seen with the pups on only one occasion. Three adults accompanying them was more common, but sometimes fewer were present. When adults were not actually seen with the pups, they were often in the trees within a few yards of them. On eight occasions single wolves were heard at distances of a mile or more. The possibility that these animals were from the adjacent pack was reduced by our observations at dusk of wolves dispersing out over the burn, and morning greeting ceremonies, to be described.

As mentioned, another pack was occasionally within a mile of the rendezvous site. This pack was much less sedentary, although we believed it too contained pups. Evidence indicated that this pack had a rendezvous site three miles away which it used early in August and returned to later in the month. This pack came to within 200 yards of the Annie Bay pack on the evening of August 15 and the following morning. Both times at least two single wolves were between the two packs, as evidenced by howling. The only record of

four adults with the pups was made on that morning. This suggested that possibly the two packs were actually sub-units of the same pack. Murie (1944) cited an example of a strange wolf trying to join a pack and being actively repelled and actually injured. No aggression was observed here.

PERIODS OF ACTIVITY

Wolves were on the burn primarily during the few hours following daybreak and before dark (Table 1). In the morning, the time they left the burn varied from 0725 to 0945 (based on seven mornings of observation). They remained longer on sunny mornings.

When not on the burn they apparently remained in the trees at its edge, as indicated by 25 separate responses from that location to pre-recorded or human simulated wolf howls. We speculate that during the heat of the day the wolves remained inactive in the trees, as no howls were heard from other localities. Kolenosky and Johnston (1967) reported from a study of radio-tagged wolves in North-western Ontario that little activity occurred from 0900 to 1500. Murie (1944) reported that Alaskan wolves normally rested throughout the day.

At nights, howling indicated that the pups and at least one adult were on or beside the burn. On four nights other adults left and were heard at various locations, presumably out hunting.

BEHAVIOUR

Pups: Sometimes pups engaged in strenuous play for an hour or more at a time. Play was interspersed with brief rest periods usually of a few minutes duration. The most common components of play were: chasing each other, running among the stumps and logs, rolling together and pawing each other. Less frequently they playfully bit one another. On three occasions one crouched behind a stump and jumped at a passing pup.

We heard no vocalizations during this play.

Play of a similar type was described by Murie (1944) and Crisler (1958), both in an arctic environment. Young and Goldman (1944) also reported that it occurs but their source of information was not described. The difficulty in observing undisturbed behaviour in forested regions accounts for its lack of documentation. Play by captive pups has been described in many reports, including one by Rutter and Pimlott (1968) on pups kept as part of this research program.

Adults: Adult wolves were often seen moving aimlessly with tail and head lowered. This type of movement was interspersed with periods of sitting or lying down. When a wolf resumed walking, it often went off in a different direction. They generally stayed within 100 yards of the pups. In the late evening they would sometimes disperse farther out over the burn.

Adults rested for long periods, usually lying in a partially curled position. Certain locations were favored, especially the base of one slightly elevated stump.

TABLE 1.—Time of day wolves visible on the burn

Time	Number days observation	Per cent days adults seen	Per cent days pups seen	Total per cent days wolves seen
Daybreak to 1000	8	63	63	88
1000 to 1900	6	17	0	17
1900 to dark	10	60	60	70

We observed adults playing among themselves on only one occasion. It lasted for only a few minutes, and consisted of jumping, rolling, pawing each other and running together.

Adult-Pup Interactions: On three occasions adults joined in the play of the pups by running and jumping with them. Once, an adult crouched and sprang at a pup, chased it and rolled it over.

Greeting Ceremony: On five occasions we observed a vigorous greeting ceremony when members of the pack returned to the rendezvous site. This ceremony occurred once when the three pups returned and four times when a single adult returned. Both pups and adults participated in all ceremonies.

The animals returning and those at the site ran towards each other with tails held high and ears forward. They frolicked together in a tight group for approximately a minute. The most dramatic element of the displays was the vigorous flicking of tails as they were held high over their backs. The ceremony terminated abruptly with the wolves walking slowly away and lying down, and the pups resuming play among themselves. These observations were very similar to ones made by Murie (1944) and Crisler (1958) in Alaska. We did not observe similar behaviour when wolves departed in the evening, as did Murie.

Wolf-Bear Interactions: Black bears (*Ursus americanus*) were seen twice at the rendezvous site. The first time, three adult wolves lying out on the burn suddenly jumped up and ran out to meet the bear which was galloping towards them. The wolves jumped at the bear, encircled it and darted in and out. The bear, still moving, swung around at the wolves, then chased one of them with the other two wolves chasing the bear. The wolves gave up the chase when they reached the trees. No actual contact was made between the participants.

The second time a bear appeared, the wolves were in the trees at the edge of the burn. The bear walked to within 100 feet of them, then began running and jumping over deadfall and disappeared beyond the wolves. No wolves came out of the trees.

FOOD

White-tailed deer (*Odocoileus virginianus*) comprise 80 per cent of the summer diet of wolves in Algonquin Park (Pimlott *et al.*, 1967).

A calculation of the number of deer required to sustain the minimum of three adult wolves in the pack for 16 days based on figures presented by

Pimlott (1967) (7.2 pounds food per day; 20 per cent wastage; proportion of fawns to adults killed 8:2; adult deer weight of 150 pounds; adjusted fawn weight of 50 pounds) suggests that the equivalent of approximately 0.4 adult deer and 5.3 fawns (total of 334 pounds) would have been utilized. An additional amount was required by the three pups.

We placed two deer hit by cars, a doe and a fawn, out at the edge of the site. Both were fully utilized by the pack, but utilization occurred at night so was not observed. The doe was placed out only three days before the pack left so contributed a relatively minor amount to the total food requirements.

We did not observe hunting or prey being killed. A search was made of the site after the wolves left, but we found no bones. This suggested that the adult wolves made their kills and fed during their nightly forays away from the site. Although no adult was observed regurgitating for the pups as has been reported by other observers (Young and Goldman, 1944; Crisler, 1958; Haber, pers. comm.), the lack of bones suggested that this was the method of feeding the pups at the Annie Bay site.

Vocalizations

The wolves at the site howled in response to auditory stimulation 37 times. This represented 52 per cent of attempts made when wolves were believed to have been present. Pre-recorded wolf howls were more successful in eliciting responses (60%) than human howls (38%) but the difference was not significant ($X^2 = 2.98$, D.F. 1, $P > .05$).

Barking occurred when a wolf approached members of the Pimlott family to within 75 feet. The wolf barked for 11 minutes, gradually moving away. Our subjective interpretation was that this behaviour represented an aggressive challenge.

Spontaneous howling (no known auditory stimulus) by the pack was heard on four nights. These nights represented all the times when single wolves were known to have been absent from the pack. This suggested that separation of pack members elicited howling. The evidence was only circumstantial, however, as wolves may have been absent on other occasions without our knowledge. The evidence of absence was the occurrence of howls of single animals away from the site during the night, and morning greeting ceremonies when animals returned to the site.

Discussion

Rendezvous sites, or "resting sites", used after wolves vacate the natal den have been described by Murie (1944), Young and Goldman (1944), Rutter and Pimlott (1968), Joslin (1967), Kolenosky and Johnston (1967). In the latter two studies more than one rendezvous site was found within the home range of a pack.

The Annie Bay rendezvous site environment, that of a border between coniferous forest and an open and at least partially wet area, fits Joslin's (1967) description of 11 sites he examined in other areas of Algonquin Park. Kolenosky

and Johnston (1967) described four "resting sites" also characterized by close proximity to water and at least semi-open forest canopy.

Reporting on the sedentary nature of packs in the summer, Joslin (1967) stated that packs remained for an average of 17 days at any one rendezvous site. Cowan (1947) described a variation in the sedentary nature of wolf packs in Alberta. The Annie Bay pack remained for a minimum of 16 days at its rendezvous site, despite the pups being almost two-thirds adult size and seemingly fully capable of travelling long distances.

Small summer home ranges have been described in Ontario by Kolenosky and Johnston (1967) for a radio-tagged female with a litter (18.3 km.^{2}) and by Joslin (1967) (8.1 square miles, 7.2 square miles, 25.0 square miles) in Algonquin Park. Since we did not know the location of other rendezvous sites that were occupied during the summer by the Annie Bay pack, our information on size of home range was incomplete. However, the sedentary nature of the pack suggested that it also had a relatively small home range.

The behaviour of the wolves in the first encounter with a bear was identical to that described by Murie (1944) when he observed wolves meeting a grizzly (*Ursus arctos*). Protection of the pups may have motivated the wolves' behaviour in both cases. Murie (1944) also found that competition at a kill between the two species resulted in similar behaviour. That wolf-bear encounters can have more serious results was documented by Rutter and Pimlott (1968) who described a female wolf killed at a den with evidence that a bear was responsible.

Howling in response to both types of auditory stimulation – pre-recorded wolf howls (60% response) and human howls (38% response) was high compared to Joslin's (1967) report of 7.9% and 16.4% respectively. This difference is partially attributable to seasonal variation. Joslin's results spanned the four summer months whereas ours were all from August. Howling is more common as the summer progresses (Joslin, 1967; Theberge, 1964).

Joslin (1967) found that human howls elicited significantly more responses than pre-recorded howls. He attributed the lower rate of response to the pre-recorded howls to the "tinny" quality of the loudspeaker. The same equipment was used at Annie Bay where significant differences did not occur. That wolves have the ability to distinguish pre-recorded wolf howls, and even pre-recorded human howls from live human howls was demonstrated by Theberge and Falls (1967). The difference in our results is not believed to be due to a difference in the ability of a human to mimic a wolf's howl. Theberge (1964) reported on a variety of loud sounds that would elicit responses. The only other explanation is that the pre-recorded howl we used, that of a sequence of pup howls, was more of a stimulus than Joslin's pre-recorded howl of adult wolves.

The circumstantial evidence that spontaneous howling occurred when wolves were absent from the pack agrees with Theberge and Falls' (1967) conclusion from a study of captive wolves that at least one type of howling is a manifestation of an emotion triggered by separation, and has an obvious value in pack cohesion.

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THE STATUS OF PINE MARTEN IN NEWFOUNDLAND

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I WISH to call to the attention of conservationists the precarious status of the Newfoundland pine marten (*Martes americana atrata* Bangs). In the past 50 years marten have disappeared from large sections of central Newfoundland. By 1960 the species' range was no longer continuous – one population was located in eastern Newfoundland in the vicinity of Gander Lake, Northwest Gander River, and Gambo Pond – Trinton Brook (Fig. 1). A second population located in western Newfoundland was concentrated between Little Grand Lake and Lloyds Lake, along the east shore of Grand Lake, and in the river valleys of Southwest Brook, Little Barachois Brook and Flat Bay Brook (Fig. 1).

The last marten sighting reported to me from the eastern population was in 1961; this population is now probably extinct. The future of the western population is not bright. At present a road is being constructed from Buchans to St. Georges, through the heart of the present range. This road will open this vast region to logging operations.

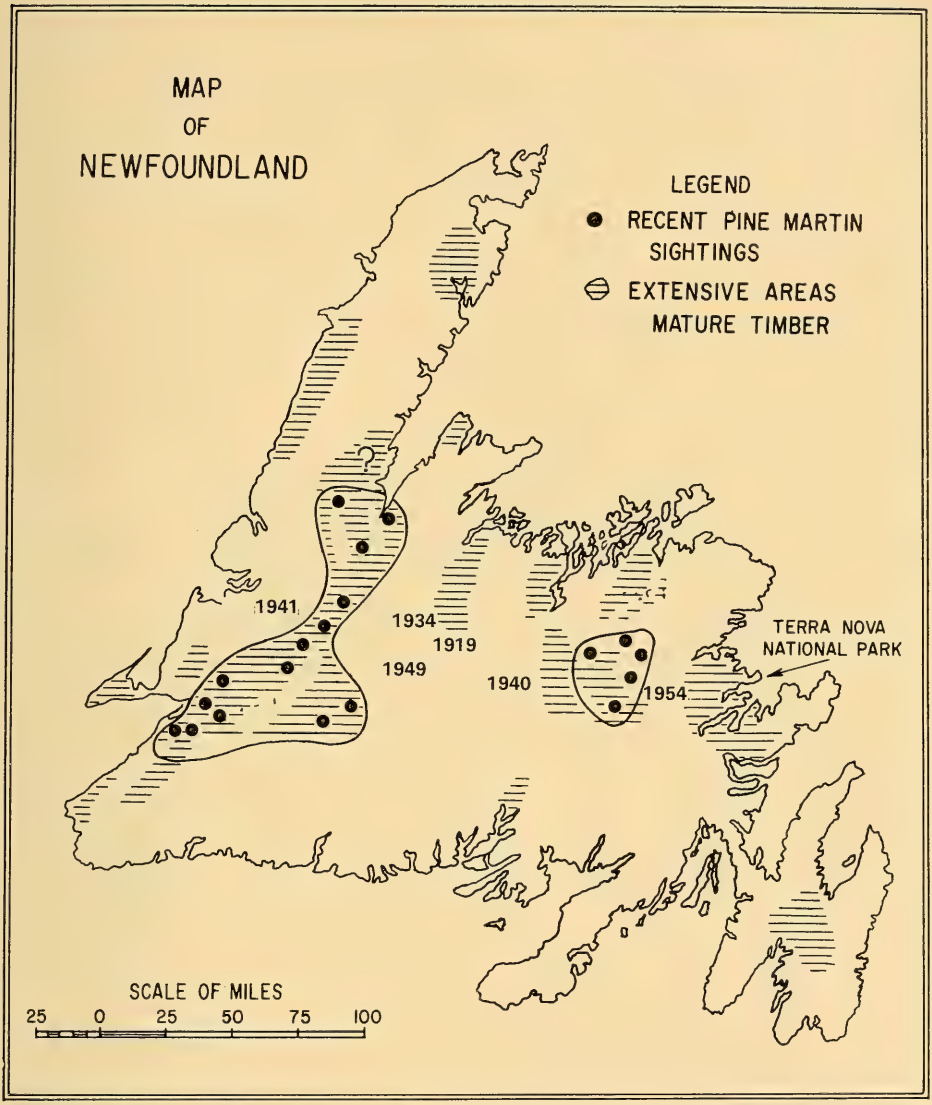

FIGURE 1. The distribution of marten in Newfoundland in the decade 1950 to 1960 based on the reports of wildlife officers. The years represent the approximate time of disappearance. Marten may now be extinct in the eastern section of the indicated range.

Apparently pine marten were never found in some forested sections of Newfoundland. Older residents on the Avalon Peninsula and the Bonavista Peninsula are not familiar with the species (Fig. 2). Again on the Northern Peninsula north of Parsons Pond, it is not clear if the species was ever common.

The pristine range of the species appears to have been almost exclusively in the Grand Falls and the Corner Brook sections of the boreal forest as outlined

FIGURE 2. The original area of productive forest in Newfoundland. No records were secured of marten having ever been present on the Bonavista or Avalon Peninsulas. The species' primary original range included the forested sections of the west coast (south of the Northern Peninsula), central Newfoundland and northeastern Newfoundland.

by Rowe (1959). These two sections encompass the most productive forests of Newfoundland.

It is not known why the species did not inhabit the extensive original spruce and fir forests of the Avalon and Bonavisa Peninsulas (Fig. 2). One hypothesis that I think worthy of testing is that these forested sections did not include sufficient large trees for denning and arboreal life requirements. Both the

Grand Falls and Corner Brook section of the boreal forest once contained extensive stands of white pine (*Pinus strobus*); where as, this tree species was largely absent from the remainder of the Island (Rowe 1959). The area now inhabited by marten contains the last dying relic stands of diseased pine. The importance of this tree species to marten could easily be checked by following winter tracks.

The correlation between the former distribution of white pine and marten abundance could be spurious – the correlation reflecting a more basic relationship between site fertility and marten status. Marten do without pine in most of North America. However the life requirement of Newfoundland marten must be unique – there are no native squirrels in Newfoundland – and one only one native mouse species (*Microtus pennsylanicus*). It is difficult to imagine how the species survived at all. The Newfoundland marten's food habits are unknown.

Marten have frequently been seen in newly logged areas. The animals appear quite tame. The decline of marten does not appear to be due to an aversion to man *per se* but rather to the logging destruction of mature forests and possibly the loss of pine forests through disease.

It is unfortunate that Terra Nova National Park does not boast a marten population and may lack suitable habitat. It is doubtful that the powerful forestry interests in Newfoundland will permit a large block of suitable habitat to be set aside for the preservation of the species.

The Wildlife Division of the Newfoundland government should undertake a life history study of the species. The first principle of the stated policy of the Wildlife Division is: ". . . to maintain all indigenous species from extinction. . ." (Walters and Pike 1961:48). Now is the time to act!

ACKNOWLEDGMENTS

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FISHERMEN'S REPORTS OF FRESHWATER AND SALTWATER MIGRATIONS OF NOVA SCOTIA EELS (*ANGUILLA ROSTRATA*)

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Introduction

Fishermen's reports have been starting points of investigations that broadened understanding of biological and fisheries management problems and enhanced values of fisheries the world over. The following reports by Nova Scotia eel fishermen and fisheries officers and discussion of these indicate promising areas for scientific study.

Saltwater-to-Freshwater Autumn Migration of Yellow-bellied Eels

On September 15, 1939, I watched a man building a "V"-shaped weir made of fine-mesh cotton netting in Moulin River near Louisdale, Richmond County. The narrow end pointed upstream. He said he was building an eel trap and always did build one about that time of year; that thousands of eels would soon run upstream from the saltwater estuary to freshwater lakes where they would pass the winter.

In 1951, Fisheries Officer E. L. Power of Arichat, Richmond County, assured me that the fisherman was quite correct; that there still were regular upstream autumn runs of eels in Moulin River and that to his certain knowledge there were similar runs in at least two neighbouring streams, River Inhabitants on Cape Breton Island, and Grand Lake Brook on Madame Island, both in Richmond County.

In 1967, Mr. A. E. Terrio, Fisheries Officer of Arichat and a long-time eel fisherman, recounted personal experiences and assembled reports for me from trustworthy fishermen of his district. He stated that upstream eel migrations are commoner than Mr. Power had suggested; that they are more or less conspicuous in all streams on Madame Island and in several Cape Breton Island streams besides River Inhabitants. He mapped sites of nine eel weirs (Figures 1 and 2) known by him to have been recently and regularly used in fishing these annual runs.

Mr. Terrio stated that these eels are yellow-bellied; that they move upstream to freshwater lakes and bury themselves in mud until spring.

Freshwater-to-Saltwater Spring Migration of Yellow-bellied Eels

Mr. Terrio also states that there are early spring migrations of yellow-bellied eels from these same streams to their saltwater estuaries and that he has observed them many times from boyhood. They occur at night. He

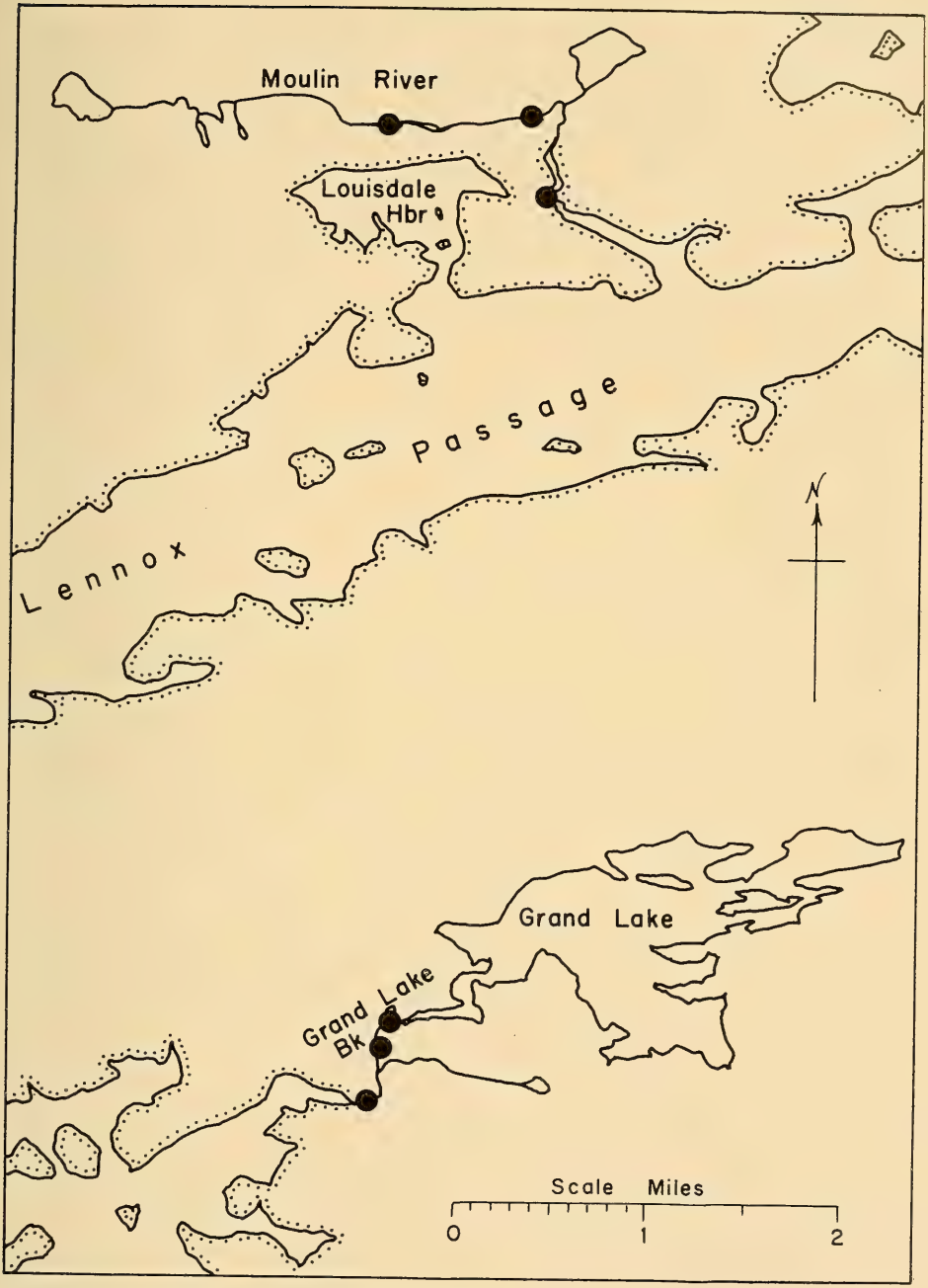

FIGURE 1. Eel weir sites (solid circles) now or recently used in fishing annual autumn saltwater-to-freshwater migrations of eels in Moulin River and Grand Lake Brook, N.S.

recollects how in spring scores of men and boys proceeded to the nearest brook, each armed with a torch and a curved steel rod with burlap wrapped around one end to form a hand grip. An old scythe blade with the sharp edge beaten down often served the purpose. The rods were used to cudgel eels as they swam through riffles in the stream. It was easy to grab them when they were stunned and throw them onto the bank. Everyone wore woollen mittens to keep his hands warm and to afford a better grip on the slippery creatures.

Mr. Terrio relayed an account by a neighbour, Mr. Ambrose A. Poirier of D'Escousse, Richmond County, of unusual circumstances attending one freshwater-to-saltwater spring migration in Langlois Lake, 5.5 miles northeast of Arichat on Madame Island. Langois Lake is a brackish, tidal water, as is the estuary of the brook that feeds into the lake at its eastern end. Both are ice-bound in winter.

Mr. Poirier stated that in March, several years ago when the lake was still ice-bound, there was a heavy rainfall during the day and water from the brook flooded out over the winter ice. The following night there was a sharp frost and a layer of shell ice formed at the surface leaving a layer of water between it and the heavy winter ice.

The following morning it was discovered that a good part of the frozen-over lake was black with eels trapped in the water between the two ice layers. Before long, every man and his son from the district were there and got themselves a mess of eels. They appeared to be moving downstream.

In explanation of this phenomenon, Mr. Poirier stated that the tide was low during the night leaving the winter ice resting firmly on the intertidal beaches of the lake. This forced all the fresh water flowing in from the brook to spread out over the winter ice covering of the lake. The eels from the brook headwaters apparently emerged at night and swam in the brook water out over the winter ice.

Summer and Winter Homes for Eels?

Mr. Terrio believes that eels involved in freshwater-to-saltwater spring runs are the same eels that made the autumn migrations in the opposite direction. He believes that many eels have saltwater summer and freshwater winter homes. I have reports in 1968 from long-experienced eel fishermen of western Nova Scotia who share this same view.

Mr. Charles Theriau of Port Mouton reported that eels are fished for local domestic use, during similar autumn and spring migrations in the following Nova Scotia streams in his area: Robertsons Lake Brook, Douglas Brook and Path Lake Brook in Port Joli district, Queens County, and Timber Island Brook and Cox Creek Brook in Port Hebert district, Shelburne County.

Mr. John L. Amiro of Lower East Pubnico, Yarmouth County, reported similar fisheries using flumes in Eel Brook Lake, Tusket River, Trout Brook, Argyle River, Pubnico Lake and French Lake all in Yarmouth County, and in Barrington River, Shelburne County. He states that downstream migrations begin in May and last for about 3 weeks; that times of upstream migrations

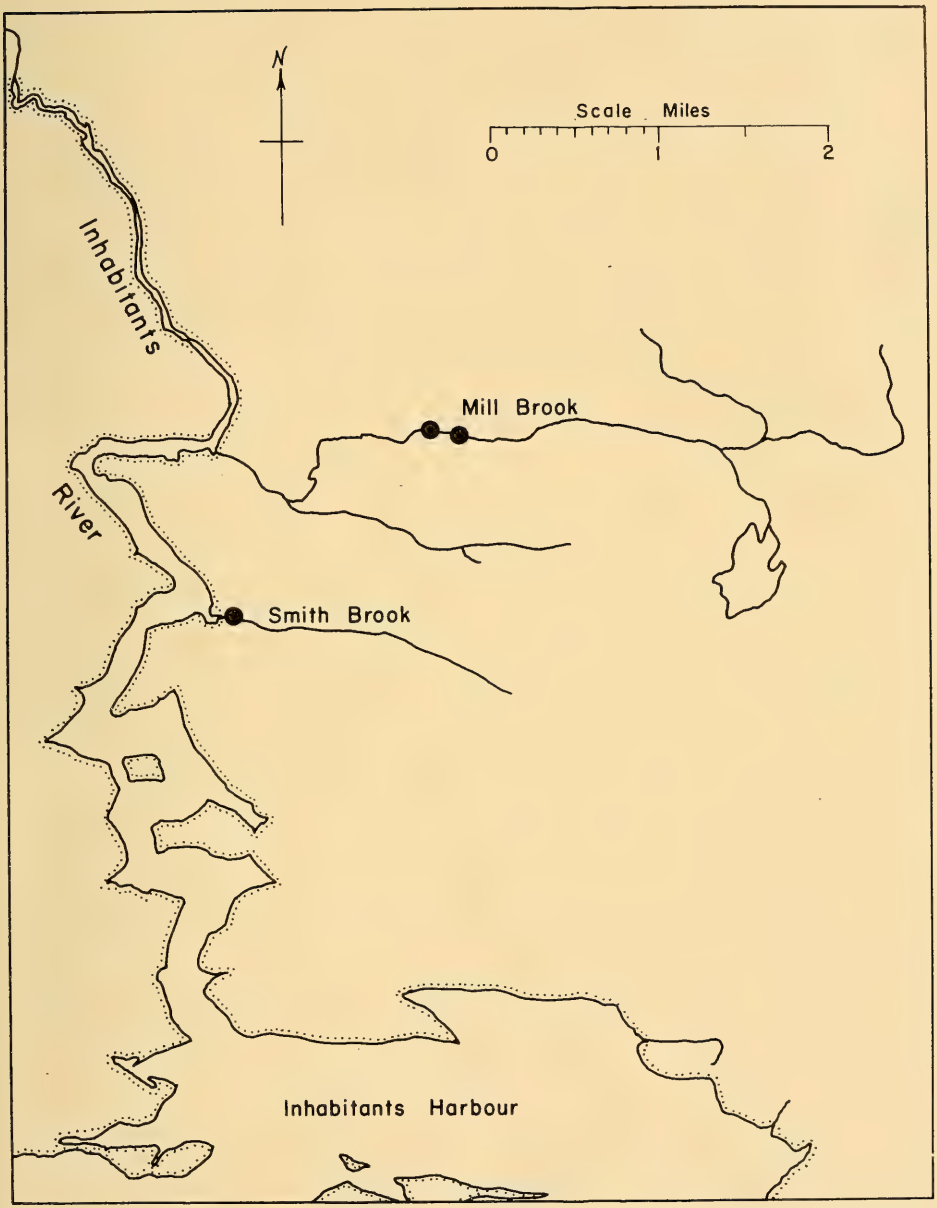

FIGURE 2. Eel weir sites (solid circles) now or recently used in fishing annual autumn saltwater-to-freshwater migrations of eels in Mill and Smith Brooks, tributaries of River Inhabitants, N.S.

vary somewhat from year to year but start at about the time of first autumn frost and also last for about 3 weeks; that the runs take place only at night and consist of partly-grown eels, ½ to 1½ pounds in weight and that most are yellow-bellied but some are white.

FRESHWATER-TO-SALTWATER AUTUMN MIGRATION OF SILVER-BELLIED EELS

Mr. Terrio states that in his district there are also migrations of white-bellied eels during the first heavy rainstorms in early autumn. These are, without doubt, the late-summer and early-autumn spawning runs that are prominent in many Nova Scotia rivers, e.g., the Margaree River, Inverness County (Medcof, 1966). According to Mr. Terrio, fishermen in the Arichat area miss these runs because their weirs are constructed so as to catch only upstream migrants.

Mr. Terrio believes these downstream migrations of white-bellied eels overlap the upstream autumn migrations of yellow-bellied eels. Mr. Amiro, on the other hand, states that in his district the downstream runs are all over before the upstream migrations begin.

FEEDING MIGRATIONS

Mr. Joseph M. Marchand, a long-time eel fisherman of Louisdale, told Mr. Terrio that in the L'Ardoise area, Richmond County, eels make feeding migrations. They run upstream to ponds where gaspereau (*Alosa pseudo-harengus*) have spawned and feed on the newly hatched fry. After a period the eels move down again to salt water until such time as other fish ascend the stream. The eels then repeat the process.

Mr. Theriau states that in the Port Mouton area eels make similar upstream runs in spring to feed on smelt (*Osmerus mordax*) spawn.

DISCUSSION

The above reports suggest that eels migrate between salt water and fresh water more commonly than the literature indicates. They also suggest problems deserving biological investigation, for instance, the migratory behaviour of this under-exploited species and the significance of belly colour of eels (white and yellow) which has been studied in part by Vladykov (1955).

The summer and winter homes migration theory is intriguing but the behavioural basis for it is so little known that it has never been subjected to proof by tagging experiments. Smith and Saunders (1955) refer to the saltwater-to-freshwater autumn eel migrations in Moulin River reported above and to similar but less conspicuous runs in the Moser River, Halifax County. Eales (1968) makes general statements on both the autumn and spring runs based partly on Richmond County information which I supplied by personal communication.

Dr. M. W. Smith has passed along a personal communication received from a Mr. Ona who fished eels commercially in the Saint John River and in

Grand Lake, Queens County, N.B., about 25 years ago. Mr. Ona stated that changing catches indicated autumn concentrations of eels over muddy bottom in man-made canals that connect the river and the lake and that eels can be trapped in worthwhile quantities only in the canals at that season. He also stated that eels wintered in the mud in these areas in vast numbers. This apparent movement to a winter home could be a freshwater equivalent of autumn saltwater-to-freshwater migrations in Nova Scotia streams.

Smith and Saunders (1955) describe downstream spring runs from lakes and streams in Charlotte County, N.B. These can scarcely be considered as parts of supposed, to-and-from winter homes migrations because the authors report no evidence of upstream autumn migrations.

Another question raised by the Nova Scotia reports is why migrations between fresh water and salt water seem more conspicuous in these coastal streams than elsewhere. A factor favouring them may be shortness of streams and consequent proximity of freshwater wintering sites and saltwater estuarine summer homes (Figures 1 and 2). Eels would not have to travel far to complete their runs.

Some fishermen say that eels living in brackish estuaries move to fresh water "to find" muddy areas for wintering. But there are muddy bottoms that seem suitable in both these habitats and in many parts of our coast (including Madame Island, according to Mr. Terrio) some eels hibernate in mud in saltwater estuaries and are speared there in winter (Day, 1948). Physical characteristics of bottoms therefore seem an unlikely basis for "selection" of freshwater wintering sites. Winter temperature difference could be a factor that was responsible in some mysterious way for the evolution of these runs that occur in autumn.

In most freshwater lakes of moderate or great depth, bottom temperatures are often static for long periods in winter at about 4°C (Birge and Juday, 1912), whereas in our saltwater estuaries temperatures range about −1.5°C for long periods in winter (Needler, 1941). Schmidt (1935) argues that *Anguilla* is a genus of tropical origin. If this be true, do some of our eels "prefer" freshwater habitats for wintering because they are warmer at that season? And what factors determine which eels winter in fresh water and which in salt water?

Mr. Poirier's report of eels being trapped between two layers of ice is interesting not only because it may relate to the supposed spring migration from winter to summer homes but also because it extends the Smith-Saunders (1955) observation that eels are occasionally active at low temperatures when one might expect them to be hibernating.

Mr. Marchand's and Mr. Theriau's descriptions of feeding migrations are of interest too. I have encountered no similar reports of short-term saltwater-freshwater movements. However, we have observations and accounts of regular mid-August descents of eels and gaspereau fry in freshwater parts of Margaree River, N.S., the eels feeding on the gaspereau (Medcof, 1966). Perhaps the movements described by Messrs. Marchand and Theriau should not be called feeding "migrations" but be considered merely as phases of a flexible feeding behaviour.

ACKNOWLEDGMENTS

I wish to thank Inspectors Power and Terrio and Messrs. Theriau, Marchand, Amiro and Ona for information they have provided and Mr. J. W. Saunders and Dr. M. W. Smith for assistance and encouragement in compiling this report.

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NESTING OF THE LONG-TAILED JAEGER IN SOUTHWEST YUKON TERRITORY – AN EXTENSION OF THE KNOWN BREEDING GROUNDS

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AN EXTENSION of the known breeding grounds of the Long-tailed Jaeger (*Stercorarius longicaudus*) was discovered during summer 1967 and noted again in 1968 while carrying out geomorphological field work in the Ruby Range of southwest Yukon Territory, Canada. The exact locality is Gladstone Lakes, about 30 miles due north of Mile 1045 Alaska Highway, 61°23′N 138°12′W. Location of the site, with respect to the presently known breeding grounds, is shown in Figure 1.

The general environment of this breeding ground extension is that of alpine tundra at an elevation of 6,300 feet on a southeast facing 14° slope. Tree-line is at 3,800 feet, about three miles distant. Well-developed solifluction lobes occur on the slope and they present, in cross section, a series of treads and risers, as in a stairway. Favourable microhabitats for both flora and fauna are provided, particularly at the fronts (risers) of the lobes, where there is late snow lie to serve as insulation, water availability through the summer from

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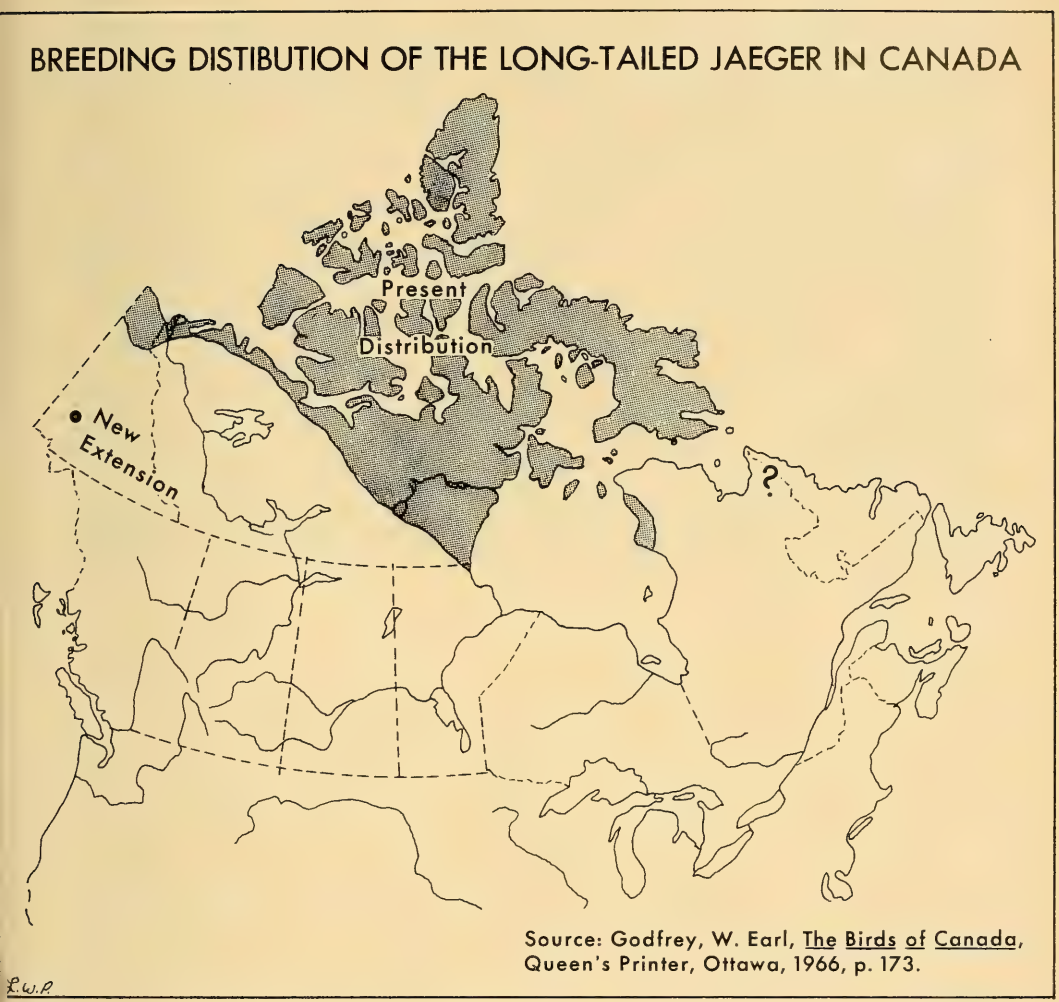

FIGURE 1. Breeding Distribution of the Long-tailed Jaeger in Canada.

melting permafrost, and a higher temperature because of the greater angle of incidence of solar radiation.

A pair of jaegers was observed to be nesting both summers, 1967 and 1968, in almost exactly the same spot. The nest was on the top (tread) of a solifluction lobe in wet and mossy cotton-grass tussocks. Dominant species include *Eriophorum angustifolium*, *Carex microchaeta*, *Salix pseudopolaris*, *Salix reticulata*, and mosses and lichens. As far as we could tell, there were no special preparations for the nest — it was simply in a small depression between two tussocks.

One offspring was born each year, apparently late in June. The picture below was taken on July 2, 1968, of the young jaeger (Figure 2). It was

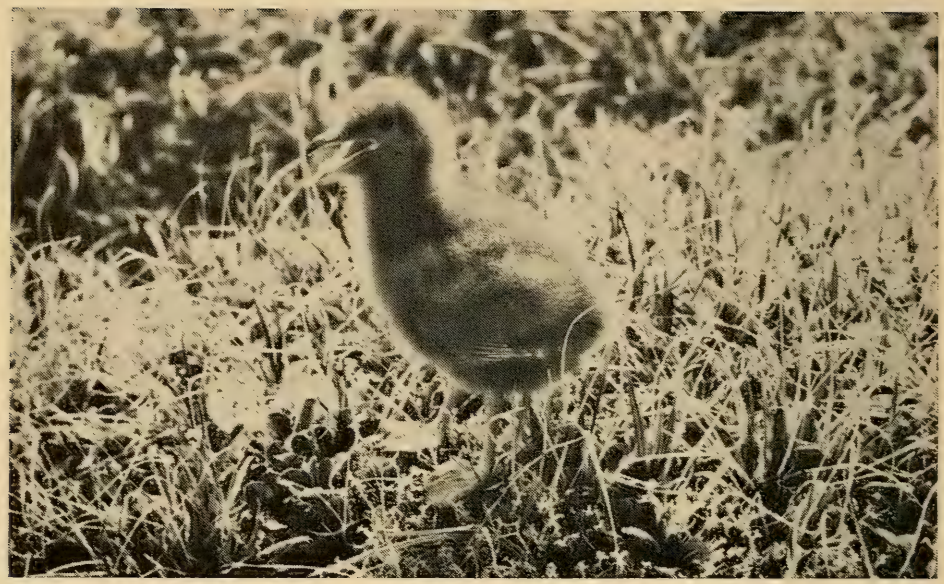

FIGURE 2. Photo of baby Jaeger taken on July 2, 1968. He is about 6 inches tall, and is assumed to be two or three days old.

perhaps a week old at the time because it could stagger around a little, but not very successfully. Life processes are very compressed and accelerated in the short tundra summer and it was interesting to note the young bird's progress. On July 16, we observed one of the parents flying over the young, diving and screeching at it. This continued incessantly until July 22, when we first saw the young bird flying.

The jaeger has remarkable eyesight and we found them to be excellent watchdogs. Nothing happened on the slope but what they knew about it. Indeed, their presence affected the ecology of the slope in important ways. For example, any eagle which came closer than two or three miles, was promptly chased away. Occasionally we would hear the jaegers begin their high shrill calls and look in the direction they were flying to see an eagle — just a speck in the sky. The same treatment was given to other unwelcome creatures such as wolf, fox, wolverine, bear, and ermine. The elimination of these carnivores from the slope during the summer was somewhat counterbalanced by the jaegers themselves, because they essentially filled the predator niche in the food chain. They harvested many of the small rodents which occurred in abundance on the slope, i.e., shrews, lemmings, voles, and mice of various kinds. For the larger burrowing mammals, however, such as ground squirrels, pika, marmot, as well as the ptarmigan, it made for a rather trouble-free existence. The jaegers' presence may, in part, be responsible for maintaining the particularly high population of these animals on this slope.

There were other Long-tailed Jaegers in the vicinity, and they occasionally visited our slope. Generally only one other jaeger would be seen and the

most we ever saw at one time was five (including the two adults and one young from our slope). The jaegers from our slope seemed to resent these visitors, however, and when they came, a great deal of screaming and chasing about the sky resulted.

The time of arrival of the jaegers in the spring is not known. They were there both years when we arrived on June 18, and as mentioned, the young was born probably in the last week of June. According to Godfrey (1966), the incubation period is 23 days, so from inference, they may have arrived late in May. As to their departure in the fall, they were still on the slope in 1967 when we left on August 24. In 1968, however, they left the slope on August 10.

ACKNOWLEDGMENTS

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LABORATORY STUDIES OF INTERACTIONS BETWEEN THE WHITE-FOOTED MOUSE AND REDBACK VOLE

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THE possible role of interspecific aggression in the habitat segregation of small mammals has been discussed by Clough (1964), Getz (1962), King (1957, Sheppe (1967), Findley (1954), and Wirtz and Pearson (1960). In certain parts of their ranges, and especially in southern New England, the white-footed mouse *Peromyscus leucopus* and redback vole, *Clethrionomys gapperi*, have different local distributional patterns which could result in part from interspecific interactions. The role of interspecific aggression in such habitat segregation of the two species is not known, however.

Although found in many types of woodlands, *P. leucopus*, attains its highest population densities in uplands (up to 60/ha); it is not very abundant in lowland swamps (seldom above 15/ha). In southern New England *C. gapperi* is restricted almost exclusively to and attains high population densities (60/ha) in such swamps. It is therefore possible that aggressive interactions between the two species could be a factor in the smaller numbers of *P. leucopus* in swamps and the absence of *C. gapperi* from uplands in southern New England.

Calhoun (1963) in analyzing snap-trap data from various regions in the northeast concluded that in some places *C. gapperi* is dominant over *P. leucopus*; in other places, however, *C. gapperi* appeared to be subordinate or there is no indication of dominance by either species. No other data are available in regard to aggressive interactions between the two species.

During a comparative study of the ecology and behavior of these two species, some data were obtained in regard to social interactions. Although the experiments were not by any means exhaustive, they do contribute information to the over all problem of habitat segregation of *C. gapperi* and *P. leucopus*.

METHODS

Indications of interspecific behavior were obtained by two methods: observing 5-min encounters between one individual of each species and by the introduction of a new animal into an established group.

Both series of observations were conducted in 26 x 76 x 30 cm aquaria. The three sides not facing the observer were covered with white cardboard and the top with a weighted board. The bottom of the chamber was covered with 3 to 5 cm of wood shavings. In the individual encounters the chamber was divided into two compartments by a removable partition. All observations were made in a laboratory in which only the observer was present. Normal overhead room lights were used during the individual encounter trials; in the 'introduction into an established group' trials, a normal photoperiod was maintained by sunlight coming in through room windows.

During the individual encounter trials, the two individuals to be tested were placed in opposite ends of the chamber, separated by the divider. They were allowed 2 min to become adjusted to the chamber; the partition was then withdrawn. I sat 1.5 m from the chamber and recorded the interactions between the two individuals during the next 5 min by whispering into a portable dictaphone. At the end of 5 min the divider was used to force the two animals into one half the chamber. Their interactions in the smaller space were observed for 1 min. Groups of five animals of each species were tested so that each individual of each group was tested against all the individuals of the other species. No individual was tested twice in succession.

For the 'introduction into an established group' studies, three individuals of a species (2 male, 1 female) were placed in the chamber. They were left together in a quiet room until they appeared to become adjusted to each other (as evidenced by resting or sleeping huddled together in a pile). Even if such huddling occurred within a few hours, trials were not started for at least two days. At that time a new animal of either species was placed in the chamber. The interactions of the group and the new animal were recorded for 10 min. Checks of the group were then made every 2 to 4 hours during the day and 6 to 8 hours during the night. The new animal was recorded as having been "accepted" into the group when it was permitted to huddle in the "pile". When it was accepted, or after four days, if it were not accepted, the new animal was removed. After 6 to 8 hours an individual of the other species

TABLE 1.—Interspecific aggressive behavior of *Peromyscus leucopus* and *Clethrionomys gapperi* as displayed in 5-min encounters between one individual of each species.

Source of Animals	Total Trials	Species	Aggressor*	Dominant	Curious	Ignored other Animal
Wild captured	50	*C. gapperi*	...	4	5	36
		P. leucopus	3	6	15	26
Lab raised	25	*C. gapperi*	1	7	...	16
		P. leucopus	1	1	10	7
Totals	75		5	18	30	85

*Individual initiating the action during an encounter.

was introduced. Five or six individuals (both sexes) of each species were introduced into each group.

Both wild-captured and laboratory-raised animals were tested. The wild-captured animals were trapped in the vicinity of Storrs, Connecticut from a swamp habitat in which both species occurred. The animals were brought into the laboratory and isolated in individual 20 x 25 x 10 cm metal cages in a battery of such cages; they could not see each other. All tests were conducted within two weeks of the time of capture.

The laboratory-raised animals were removed from their parents at aproximately 21-30 days and isolated in individual cages. These mice were tested at approximately four months of age. The stock for *P. leucopus* was live-trapped in the vicinity of Storrs, Connecticut; second or third generation animals were used. The stock for *C. gapperi* was from Alger County, Michigan; they had been in the laboratory for 4 or 5 generations.

RESULTS

Individual encounters: Determination of dominant and subordinate position of an individual was based on criteria used in a previous study (Getz, 1962). There was very little indication of dominance on the part of either species. Only 18 instances of dominance were observed in a total of 75 trials involving 15 individuals of each species (Table 1). There was no similarity between the behavior of the laboratory raised and wild captured animals. In light of the small over all percentage of dominance in the individual encounters, differences between laboratory-raised and wild-captured animals do not appear to have any significance, however. Neither species appears to be significantly dominant over the other under these laboratory conditions.

Table 1 shows that in the majority of the individual encounter trials, the animals either appeared to ignore each other or at most to be mildly curious of the presence of the other animal. In a large number of the trials the animals wandered about their end of the cage, chewing on shavings or grooming themselves, and paying no noticeable attention to the other animal. Sometimes they wandered over the entire cage without showing any signs of interactions,

TABLE 2.—Interspecific aggressive behavior as displayed by interactions between an established group of 3 individuals of one species and a new animal introduced into the chamber.

Resident species	Introduced species	No. of introductions	Resident* dominant	Introduced animal immediately accepted**	Introduced animal not accepted	No aggression displayed
C. gapperi	C. g.	6	6	...	2	...
(Wild capt)	P. l.	5	2	3	...	3
C. gapperi	C. g.	5	...	...	...	5
(Lab raised)	P. l.	6	...	2	...	6
P. leucopus	P. l.	6	...	6	...	6
(Wild capt)	C. g.	6	...	1	...	6
P. leucopus	P. l.	4	3	1	3	1
(Lab raised)	C. g.	5	1	...	1	4
Totals		43	12	13	6	31

*The introduced animal was not dominant in any of the trials.
**Within 1 hour.

even when passing within 4 to 5 cm of each other. There was no interspecific grooming.

In other instances one or both of the animals would stare intently at the other. This was described as "curious" behavior. If the other animal was moving around its end of the cage, the "curious" individual would watch every movement of the other animal. In many cases such an individual would remain almost completely motionless during the entire 5-min trial, moving only his head so as to follow the movements of the other animal. In other cases the animal doing the staring would stretch its neck and body out toward the other animal and remain in such a position most of the 5 min. *P. leucopus* displayed much more such "curious" behavior than did *C. gapperi* (Table 1).

There was no increase in any aggressive display when the animals were crowded into the smaller compartment in any of the trials; they continued to react towards each other as they had in the larger chamber.

There was no difference in the observed interactions which correlated with the sexes of the animals of the trial.

Introduction into an established group: Indications of aggressive behavior during the first 10 min a new animal was in the chamber were observed in only 12 of the 43 total introductions involving both species. In all 12 cases the members of the established group were obviously the dominants. In 13 instances the new animal was immediately (within 1 hour) accepted into the group. In six instances the introduced animal was not accepted at all by the group during the 4-day trial.

There was no consistent trend in the above observations. Of the 12 observations of dominance of the established group, nine involved introduced individuals of the same species as that of the established group (Table 2).

Likewise five of the six individuals never accepted into a group involved the same species as the established group. Individuals of the other species were in general accepted as readily as or more readily than individuals of the other species.

The wild-captured *C. gapperi* displayed more aggressiveness against introduced animals of both species than did the laboratory-raised animals. The laboratory-raised *P. leucopus*, on the other hand, were more aggressive than were the wild captured individuals. This is exactly the opposite trend as noted in the 'individual encounter' trials.

There was no noticeable difference in behavior towards introduced males and females.

DISCUSSION

The above observations indicate no aggressive behavior which could account for the habitat segregation of the two species in southern New England. In general there was very little aggressiveness between the two species and even that which was observed did not indicate any definite trend for one species to be more aggressive or dominant over the other. Aggression was directed at individuals of their own species as frequently as against the other species.

It is not possible to evaluate the significance of the "curious" behavior in regard to interactions between the two species. The intent staring at and apparent avoidance of *C. gapperi* by *P. leucopus* could possibly be an indication of some type of interaction with significance in the habitat segregation of the two species. The present data were not sufficient to determine if this behavior had such significance under natural conditions or was an artifact of the laboratory conditions. More extensive studies are needed to make this evaluation.

A greater water requirement (related to a relatively inefficient kidney) is a major reason for the restriction of *C. gapperi* to wet swamps in southern New England; nothing in the water requirements of *P. leucopus* accounts for their lower numbers in swamps, however (Getz, 1968). *P. leucopus* avoids standing water more than does *C. gapperi* and is less capable of sustained swimming (Getz, 1967). As many swamps contain standing water for considerable periods during the year, such reactions to water may play a part in the difference in the local distributions of the two species. It does not appear to be the primary factor, however. The greater aboreality of *P. leucopus* (Nicholson, 1941; Getz and Ginsberg, In Press) should reduce the influence of standing water on the distribution of *P. leucopus*.

Lower food availability in swamps as compared to uplands may be a factor in the smaller numbers of *P. leucopus* in swamps (Getz, 1961). This conclusion needs to be tested in the field, however, to determine its validity.

Therefore, while it appears that *C. gapperi* is not found in upland situations in southern New England because of water requirements, the reason for low numbers of *P. leucopus* in swamps is still an open question. There is, however, no indication that interspecific aggressive behavior plays a major role in the habitat segregation of the two species.

SUMMARY

Interspecific interactions of the white-footed mouse, *Peromyscus leucopus*, and the redback vole, *Clethrionomys gapperi*, were observed during 5-min encounters between one individual of each species and by reactions of established groups of 3 to new individuals. There were only 18 instances of dominance in 75 individual encounters involving 15 individuals of each species; *P. leucopus* was dominant in 7, *C. gapperi* in 11. In the majority of the trials the two individuals ignored each other. When introduced into a chamber with an established group, a new animal of the other species was accepted into the group as readily as or more readily than was an individual of the same species. There was no indication that interspecific aggression plays a major role in the habitat segregation of *P. leucopus* and *C. gapperi*.

ACKNOWLEDGMENTS

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SOME TRICHOPTERA OF THE HUBBARD BROOK EXPERIMENTAL FOREST IN CENTRAL NEW HAMPSHIRE[1]

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INTRODUCTION

IN 1963 an intensive ecological study was begun of several forested watershed-ecosystems in the White Mountain National Forest of central New Hampshire (Bormann and Likens 1967). These studies have been done in cooperation with the Northeastern Forest Experiment Station in the Hubbard Brook Experimental Forest near West Thornton, New Hampshire. The goal of this study has been to evaluate as many of the parameters of the ecosystem as possible, in order to understand the function of the entire system. Data have been accumulated on hydrologic-nutrient cycle interaction, biomass, productivity, and phenology of the vegetation, and many other parameters of the ecosystem. Pertinent to this study are data on the presence, distribution and size of trichopteran populations in the drainage streams of this forested ecosystem. Extensive collections of larval and adult caddisflies have been made in New Hampshire (e.g. Flint 1960; Morse and Blickle 1953, 1957), but few detailed studies had been done for a specific habitat and none had been done within the Hubbard Brook Experimental Forest. Therefore basic studies were begun in 1965 to obtain information about the Trichoptera in these watersheds.

HUBBARD BROOK EXPERIMENTAL FOREST

The Hubbard Brook Experimental Forest, covering 3076 hectares, is typified by rugged terrain, ranging from 229 to 1006 m altitude, and is covered by unbroken forest of second-growth northern hardwoods, primarily sugar maple, yellow birch and beech. Some red spruce and balsam fir may be found at the higher elevations. Climate, although varying in response to altitude, may be classified as humid continental with short, cool summers and long, cold winters (Trewartha 1954). The average air temperature in July is 19° C, while the average January temperature is −9° C. Annual precipitation is about 121 cm, of which one-third to one-quarter is snow (U.S. Forest Service 1964).

Within the larger area, a number of small tributary watersheds have been chosen for intensive study of hydrologic and nutrient parameters. These watersheds (ecosystems) range in size from 12 to 43 hectares and in altitude from 500 to 800 m.

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Watershed 4 was selected for this study because of its larger drainage stream and the overall size of the watershed (36.1 ha). The actual length of the drainage stream above the gauging station in watershed 4 is 755 m. There are three first order branches of this stream, two of which remained dry during most of the summer of 1966. These two branches were considered unlikely to support caddisfly larvae, and they were ignored in this study. The bedrock of the watersheds and the drainage streams is the Littleton Formation, which in this area is a sillimanite-zone gneiss.

Although the precipitation in the region is equally distributed among the months, stream flow is unequally distributed (Likens *et al.* 1967). By late summer and early autumn, streamflow is usually very low and in some cases may be negligible. Snow pack melt causes major streamflow during the spring.

Drainage Stream

During the summer, the drainage stream of watershed 4 is in deep shade beneath the forest canopy, and water temperatures do not vary greatly. Variation during the day is not more than a degree or two, with the maximum temperature occurring about 1500 hours. The annual range in temperature is from about 0 to 17.5° C. The altitudinal temperature gradient during mid-summer is about 5-7° C, and may be as much as 12° C. The steepest thermal gradient is confined largely to the upper 50 m of the stream.

The streamwater is clear and contains little dissolved materials (Likens *et al.* 1967). Dissolved oxygen is normally near saturation, and the water varies in pH from 4.6 to 6.4 according to flow and the time of year.

The streamed channel is characterized by cobbles and small boulders, occasional bedrock exposures and numerous "dams" of organic debris. The bank-full area of the water-bearing streambed of watershed 4 in June 1966 was 1577 m^2 or 0.5% of the total area of this watershed. The average width of the lower portion of the stream is 2.9 m, while the upper portion is about 1.4 m wide. Stream velocity can be rapid (up to 200 cm/sec at the surface during periods of heavy rain) and turbulent as might be expected from the average slope (28%) and bottom composition (Minnikin 1920). At times of low stream flow, however, the flow is greatly reduced, especially in the upper portion. It can be reduced to mere seepage from one pool to the next.

A survey of the bottom composition in the drainage stream of watershed 4 was made during the summer of 1966. This was done by three observers estimating the percentage of the bank-full channel that was covered by inorganic or organic materials every 10 to 20 m throughout the course of the stream. The results of this survey indicated that in the lower reaches of the stream the bottom composition was approximately 20% organic, but increased to some 70-80% organic near the headwaters and eventually merged with the litter of the forest floor.

Adult Collections

Lighted traps (Fig. 1) were used to collect adult Trichoptera. Collections were made at distances of 129 m (elevation 448 m), 420 m (elevation 512 m)

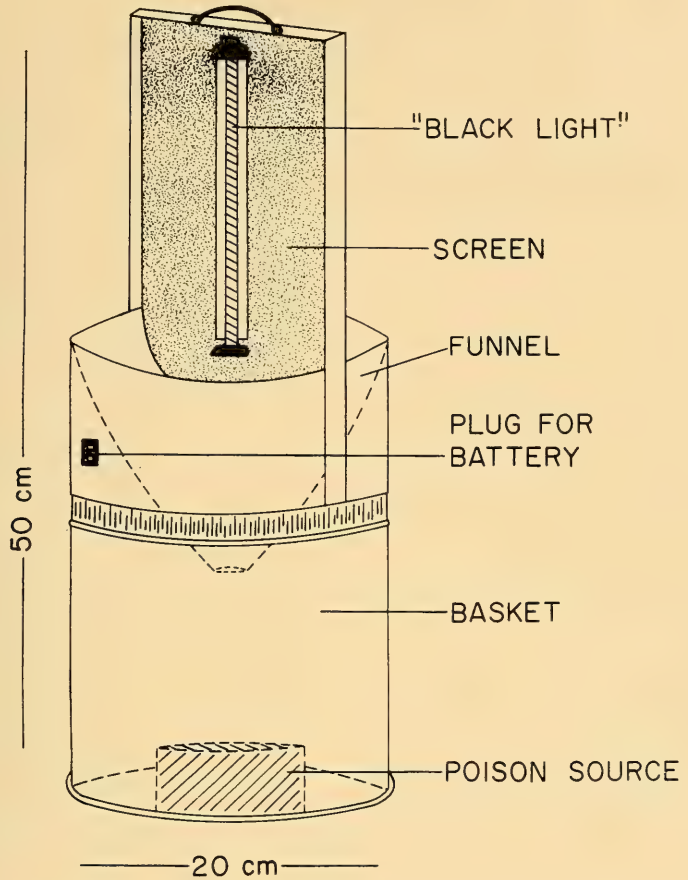

Figure 1. Lighted trap for adult Trichoptera. The 6-watt General Electric "black light" is powered by a 12-volt storage battery. Insects hit the screen, fall through the funnel into the bucket and are killed by ethyl acetate fumes. The fumes are emitted from a plaster-of-paris block that was soaked in ethyl acetate.

and 700 m (elevation 573 m) along the course of the stream above the weir in watershed 4. Over a period of nine weeks, starting 4 July 1966 and ending 2 September 1966, a trap was set once a week at each of these sites. Exceptions to this scheme occurred in the first and third weeks when collections were obtained from only two sites. The upper site was missed the first week, and the lower site was missed the third week.

It was not possible to collect at all three sites on the same night since only two traps were available. All of the sites were within 2 m of the stream, and were selected to give approximately equal spacing along the stream course and to avoid shielding by vegetation as much as possible. The traps were set out approximately one-half hour before sunset and were collected the next morning.

TABLE 1. — List of species collected within the Hubbard Brook Experimental Forest during 1965-1966

Species	Adult[1,2]	Larvae[2]
HYDROPSYCHIDAE		
Diplectrona modesta Bks.	I	+
Hydropsyche slossonae Bks.	I	—
H. sparna Ross	II	—
Parapsyche apicalis (Bks).	V	+
LEPIDOSTOMATIDAE		
Lepidostoma frosti (Milne)	IV	+
L. griseum (Bks).	VI	+†
L. lydia Ross	II	—
L. sackeni (Bks).	II	—
L. sommermanae Ross	I	—
L. swannanoa Ross	I	—
Theliopsyche grisea (Hag).	IV	—
LIMNEPHILIDAE		
Ironoquia lyratus (Ross)	IV	+†
Limnephilus consocius Walk.	I	—
L. indivisus Walk.	II	—
L. moestus Bks.	V	—
L. ornatus Bks.	I	—
L. submonilifer Walk.	IV	—
Neophylax aniqua Ross	—	—
N. consimilis Bett.	II	—
N. ornatus Bks.	I	—
Onocosmoecus quadrinotatus Bks.	II	—
Platycentropus indistinctus Walk.	I	—
P. radiatus (Say)	II	—
Pseudostenophylax sparsus (Bks.)	IV	—
P. uniformis Bett.	V	+
Psychoglypha alaskensis (Bks.)	—	+
Psycnopsyche circularis (Prov.)	V†	—
P. divergens (Walk.)	VI	+
P. gentilis (McL.)	IV	+
P. guttifer (Walk.)	VI	—
P. luculenta (Bett.)	VI	+
P. scabripennis (Ramb.)	V	+†
MOLANNIDAE		
Molanna blenda Sibl.	IV	+†
ODONTOCERIDAE		
Psilotreta frontalis Bks.	III	+
PHILOPOTAMIDAE		
Dolophiloides distinctus (Walk.)	III	+
Wormaldia moesta (Bks.)	VI	+†
PHYRGANIDAE		
Banksiola crotchi Bks.	I	—
Oligostomis sp. A*	(—)	+
Oligostomis sp. B*	(—)	+
Ptilostomis ocellifera (Walk.)	II	—
PSYCHOMYTIDAE		
Lype diversa (Bks.)	I	—
Nyctiophylax vestitus (Hag.)	I†	—
Polycentropus cinereus Hag.	III	—

Table 1. (*Continued*)

Species	Adult[1,2]	Larvae[2]
P. elarus Ross	(+)**	–
P. maculatus Bks.	(+)**	–
RHYACOPHILIDAE		
Rhyacophila carolina Bks.	III	–
R. fuscula (Walk.)	III	–
R. glaberrima Ulm.	V	–
R. invaria (Walk.)	–	+†
Rhyacophila sp. (1 ♀)	II	–
Total species	45	19
Total species represented by both adults and larvae	50	

[1]The relative number of adult individuals for each species, based on total collection of 1706 individuals obtained by lighted trap during 1966 is indicated by:
(I) = 1 (III) = 5–13 (V) = 41–120
(II) = 2–4 (IV) = 14–40 (VI) = 121–364
[2](†) indicates tentative identification.
(–) not found.
(+) found but not quantified.
*Designations as "species A" and "species B" are those of the authors.
***Polycentropus elarus* and *P. maculatus* totaled 96 individuals. The number in each species is unknown.

Larval Collections

Collection of larval forms from the stream was much less extensive than that done for adults. Substrate sieving and various hand collection techniques were employed once during the winter and twice in the spring, as well as numerous occasions during the summer.

Results

A total of fifty species of Trichoptera were collected from watershed 4 of the Hubbard Brook Experimental Forest (Table 1). Forty-five adult species are represented and nineteen species of larvae. Five of the nineteen larval species were not found as adults.

Three species had not been reported previously for New Hampshire (Morse and Blickle 1953, 1957). Of these three, only *Theliopsyche grisea* (Hag.) was collected for the first time in the state. *Lepidostoma sommermanae* (Ross) and *Neophylax consimilis* (Bett.) have not been reported previously in the state although there are unpublished records of previous collections. (W. Morse, personal communication).

A total of 1706 adult caddisflies were collected in the lighted traps during the summer. Of these, 747 were obtained at an elevation of 448 m, 538 at 512 m and 421 at 573 m. The most obvious difference in distribution and abundance was shown by the results for adults of *Pycnopsyche divergens* (Walk.). For the summer, 4 individuals were collected at the lowest site,

7 at the middle and 138 at the highest. The larvae of this species might be expected more commonly in the upper portion of watershed 4 since they normally inhabit very small, spring-fed brooklets (Flint 1960).

DISCUSSION

How well the list of species (Table 1) represents the actual resident population of watershed 4 depends on the degree to which the sample is representative and on the extent of migration into the area by "foreign" species.

An adequate sampling period is, of course, necessary for a representative sample. The optimum period for sampling the adult populations would have been longer, beginning in the spring and extending into the fall. In terms of the entire population, however, it is felt that the most important weeks were sampled. This was suggested by the data of Morse and Blickle (1953) which indicate that the months of July and August include the most intensive portion of the flight periods of most species. Nevertheless, there might have been some species for which the flight period was not sampled at all. This may explain the fact that five species, represented by larval individuals, were not also represented by adults.

In addition to providing a more complete list, a longer sampling period would have allowed us to establish more accurately the relative abundance relationships (Table 1). That is, the flight periods of some species coincided to a greater degree with our collection period than the flight periods of others. Dates of previous collections in New Hampshire indicate that this is the case (Morse and Blickle, 1953).

Some support for considering the sample as representative is provided by the frequency distribution of species and individuals in the total sample (Fig. 2). The relationship between number of species and number of individuals per species is logarithmic. Similar log-normal distributions have been considered typical for various animal populations (Williams, 1964).

Migration of adult caddisflies into the watershed, from different habitats with different trichopteran species, may have occurred. Aquatic environments differing from the stream of watershed 4 are within distances conceivably travelled by adults (Roos 1957). Some 920 m beyond our lowest collection station the stream from watershed 4 drains into Hubbard Brook. Hubbard Brook is a much larger and somewhat warmer stream. Also, Mirror Lake is only 4 km distance. Trichoptera are considered to be generally weak fliers, but certainly with the aid of wind, their travelling such distances is likely. The incidence of such occurrences in watershed 4 is probably low, but is highly conjectural from our data.

Because of the uncertainty of adult migration, further statements about altitudinal differences in species distribution probably is unwarranted from our data. Except for *Pycnopsyche divergens* (Walk.), where differences in abundance with altitude are quite marked, data for other species collected with the lighted traps are not extensive enough to establish significance.

Extensive samples from the larval population must be obtained to determine any correlation between specific distribution differences and environmental

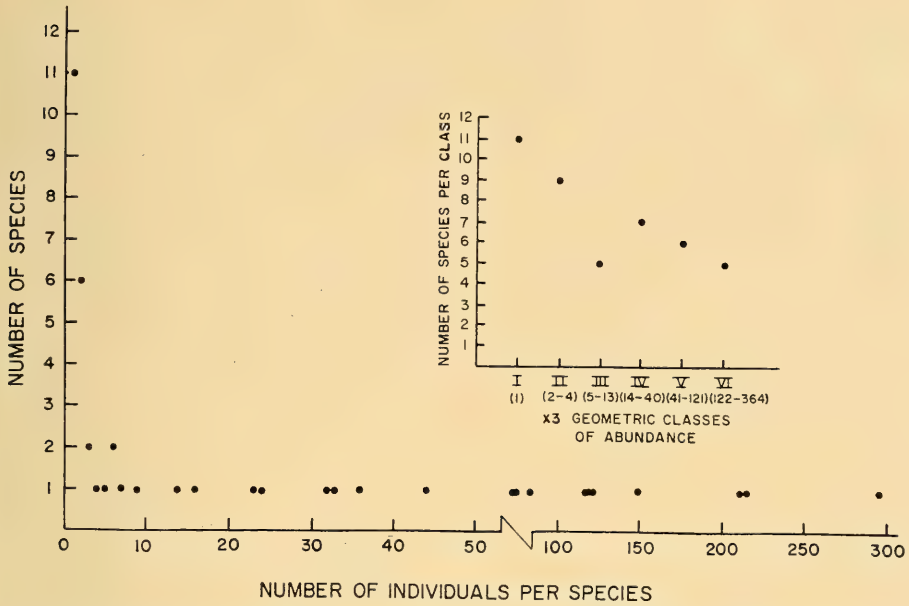

Figure 2. Frequency distribution of species of adult Trichoptera with different numbers of individuals obtained with a lighted trap during the summer of 1966.

factors. For example, significant differences would be expected on the basis of the large increase in organic matter in the stream with increased elevation. Ulfstrand (1967) considers substrate and food to be the most important factors in influencing larval distribution, whereas current velocity is primarily of indirect importance through its effect on food and substrate composition.

Summary

1. Fifty species of Trichoptera were collected from watershed 4 of the Hubbard Brook Experimental Forest during 1966. Forty-five species of adults and 19 species of larvae were recorded. Adults were collected with lighted traps from 4 July to 2 September 1966.
2. *Theliopsyche grisea* (Hag.), *Lepidostoma sommermanae* (Ross), and *Neophylax consimilis* Bett. represented new records for New Hampshire.

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NOTES

Postmetamorphic Basking Aggregations of the Boreal Toad, *Bufo boreas boreas*

While collecting in Waterton Lakes National Park, Alberta, Canada, three basking aggregations of juvenile *Bufo boreas boreas* were observed. All observations were made in a three acre swamp and pond area created by two beaver dams. There were two major fingers of water at the north end of the pond area and lowering water had left a narrow muddy bank along the edges of the water. This swamp and pond area is located 1½ miles NW of Canadian Highway 5 on the south side of the Red Rock Canyon Road, Waterton Lakes National Park, Alberta, at 4,500 feet of elevation.

The first observations were made on 6 August 1968, at 11 a.m. The first aggregation consisted of about 300 juvenile toads stacked two or three deep in a square foot area exposed to the direct rays of the sun along a small irregularity of the finger of the pond. All moved in mass into the water when disturbed. The temperature on the basking aggregation was 26°C., the water temperature 20°C., and the air temperature 24°C. This small irregularity of the pond was in the form of an elongated U and had a narrow muddy bank packed evenly by the toad aggregation. Another toad aggregation of about 200 individuals was observed in another irregularity about two feet away. Farther down the long finger of the pond was a level muddy area with small patches of short grass. This area was about 6 feet square. There was a large aggregation of around 1,000 toads and several smaller aggregations in *this* area, all in the direct rays of the sun and in piles several deep. All individuals in the aggregations were inactive although alert and readily moved towards and into the water when disturbed.

In all areas where basking aggregations occurred, very few juveniles were found in the surrounding vegetation and were aggregated on bare ground rather than short grass. The ground where basking aggregations were present was packed evenly with numerous round depressions the size of a juvenile toad.

The three major aggregations were present early in the afternoon, still in the direct rays of the sun.

By 6:30 p.m. the same day, the aggregations had dispersed from the first two irregularities along the finger of water. The juveniles were now numerous in the surrounding vegetation, under banks and other objects. They appeared to be dispersed for feeding. The air temperature was 22°C. and the temperature in the tall grass where the juvenile toads were numerous was 24°C. Most of the large aggregation had also dispersed to the surrounding grass and up and down the shoreline. One aggregation of about 300 juveniles still existed in the middle of the 6 foot area.

The next observations were made at 8 a.m. on 7 August 1968. The juvenile toads were difficult to find and were cold and sluggish in the tall grass, under banks and other sheltered spots. A small aggregation formed on top of a downed log where the first rays of the sun were hitting. The air temperature was 9°C., the water 12°C., and the temperature on the log where the small aggregation existed was 11°C.

Twenty juveniles were randomly collected and preserved. The snout-vent lengths ranged from 13.0 mm. to 16.8 mm. with an average snout-vent length of 15.4 mm.

Mullally and Cunningham (1956) and Karlstrom (1962) have reported apparent basking in the sun by adults of the Yosemite toad, *Bufo canorus*. They suggested that basking by the Yosemite toad was an important behavioral adaptation when environmental temperatures were low. Basking enabled the Yosemite toad to obtain sufficient heat to feed normally and perform other activities. Similarly,

basking aggregations in juvenile *B. b. boreas* would result in their utilization of direct sunlight as an extremely important adaptation to life in the cool temperatures of Waterton Lakes National Park. These basking aggregations of juvenile toads probably served the function of raising their body temperatures to permit greater activity and feeding. There were large aggregations early in the day when cooler temperatures existed and then dispersal from the aggregations for feeding later in the day during and after the warmest temperatures.

Color slides were taken of these aggregations, but reproduction in black and white was not feasible. These slides are available upon request to the authors. Our thanks to Francis R. Cook, and J. R. B. Coleman for their help in obtaining a permit to collect in Waterton Lakes National Park, and to Dr. Charles C. Carpenter for reading the manuscript.

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A Reconsideration of the Relationship of *Barbula johansenii* (Musci)

Barbula johansenii is a rare moss known from four widely scattered localities in the North. It was first found by Frits Johansen on Victoria Island (ca. 69°30' N, 115° W) and described by Williams (1921) in one of the reports of the Canadian Arctic Expedition of 1913-18. Steere (1952) reported it from the Brooks Range of arctic Alaska (68°12' N, 152°7' W), and Savicz-Ljubitskaja (1964) recorded its occurrence in the Lena River valley of eastern Siberia (ca. 71°40' N, 127°10' E). In 1965 I reported the first collection outside the arctic in the Canadian Rocky Mountains, at Baker Creek, Banff National Park (ca. 51°30' N, 116° W), Alberta.

The species is similar in gametophytic characteristics to *Barbula acuta* (Brid.) Brid. and its common arctic expression, *B. icmadophila* Schimp., but is easily recognized by long, fleshy, swollen leaf tips which are regularly caducous. Both Williams and Savicz-Ljubitskaja observed proliferations from the ends of fallen leaf tips, indicating an apparent function in vegetative reproduction. Adequate descriptions of the gametophytes may be found in publications by Williams (1921), Steere (1938), and Savicz-Ljubitskaja (1964). Williams' illustrations were reproduced by Steere in Grout's *Moss Flora of North America* (1938), and Savicz-Ljubitskaja (1964) provided excellent drawings. The sporophytes have, until now, been unknown.

Recently, quite by chance, I discovered fruiting material in a Canadian collection made by Thomas Drummond and included as an unmixed tuft with *Didymodon tophaceus* (Brid.) Jur. in his *Musci Americani* (*Rocky Mountains*), no. 120 [distributed as *D. trifarius* (Hedw.) Brid.], at least as represented in the herbarium of the University of Michigan. The specimen was presumably collected "about the Falls of Niagara." Such accidental mixtures are commonly found in Drummond's exsiccati set (1828), and the labels are neither informative nor accurate. For phytogeographic reasons, I am guessing that this collection actually came from western Canada and probably from the calcareous habitats of the Rocky Mountains as most,

though not all of Drummond's collections did. (A recent report by Bird, 1967, gives useful information on Drummond's itinerary up the Hudson River and across Canada to the Rocky Mountains. The title of the exsiccati is misleading, as many of the collections came from the vicinity of Niagara Falls and elsewhere in Upper Canada, as Ontario was then called, and also in various ill-defined parts of the central Canadian prairies.)

The sporophytes indicate a relationship to *Didymodon* rather than to *Barbula* because of short, erect peristome teeth (rather than the long, spirally twisted teeth so highly characteristic of *Barbula*),and a nomenclatural transfer is required: ***Didymodon johansenii*** (Williams) n. comb. *Barbula johansenii* Williams, Report Canad. Arctic Exped. 1913-18, Bot. 4E: 4. 1921. A description of essential features of fruiting plants follows:

Upper and perichaetial leaves conspicuously enlarged (about 2 mm. long as compared with the lower leaves which are 1.5 mm. long or less and narrower at the base), slenderly subulate from a broad, ovate base, the subulae nearly always broken off. Setae 7-8 mm. long, dark-red; capsules 1.2-1.3 mm. long, oblong-cylindric, erect and symmetric, dark-red; annulus differentiated; operculum not seen; peristome teeth short and slender but well developed, about 100 μ high, erect, imperfectly divided into 2 terete forks, pale, finely papillose-roughened. Spores spherical, finely papillose, 11-13 μ in diameter. Calyptrae cucullate, smooth, naked.

Steere (1953), in an interesting and provocative contribution to arctic phytogeography, called attention to a small group of rare bryophytes which are essentially limited to high northern latitudes and may have survived the Pleistocene in unglaciated parts of the High Arctic, in the western Arctic Archipelago of Canada, parts of the Yukon, and the Brooks Range of Alaska. The fact that some of them, such as *Barbula johansenii,* occur sparingly in montane habitats south of the arctic, does not disprove Steere's thesis, as it is possible that such species may have escaped glaciation in some localized niches in the Canadian Rocky Mountains as well as in a northern nunatak of greater extent and greater import. Such disjunctions do present the interesting possibility, however, of a survival farther south in the American Rocky Mountains and a secondary invasion of the North in post-Pleistocene times.

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Notes on Birds of the Iron Bridge, Ontario, Region

FROM June 14 to 29, 1966 the writer, assisted by Messrs. Frank Cosenzo and Ted Miller, collected ornithological material for the bird research collection of the Museum of Natural Sciences, National Museums of Canada. Work was centred at Iron Bridge, Ontario, with occasional trips west to Thessalon; east to Blind River; and north to about 25 miles north of Iron Bridge.

117 species were identified in the region. The status of most species was similar to that in the Sault Ste. Marie region, Ontario, as recorded by Snyder (1942) and Warburton (1950). The status of the following few species, however, seems noteworthy.

Strix nebulosa Forster, GREAT GRAY OWL

Remnants of one individual were found near Iron Bridge on June 26. It had been dead for some months and doubtless came south as part of the great irruption during the winter of 1965-1966 (Goodwin 1966).

Asio otus (Linnaeus), LONG-EARED OWL

On June 26 a nest of this owl was located in extensive forest ten miles north of Iron Bridge. It was situated about 40 feet up in a 55-foot white spruce and contained three well-developed young. Definite nesting records of this species appear to be few in that part of Ontario.

Myiarchus crinitus boreus Bangs, GREAT CRESTED FLYCATCHER

Three were observed on June 15, and two on June 19 and 22, near Iron Bridge. It apparently is near the northern periphery of its range there.

Stelgidopteryx ruficolis serripennis (Audubon), ROUGH-WINGED SWALLOW

Two were noted near Iron Bridge on June 22. The species is doubtless on the northern edge of its range there. Perhaps it is a recent arrival for it was not recorded by Snyder (1942) in the Sault Ste. Marie region and it has just now been found nesting six miles west of Thessalon by Denis (1968). Specimen: 1 ad. ♂ June 22, Iron Bridge.

Corvus corax Linnaeus, COMMON RAVEN

Fairly common west at least to Thessalon. We observed it on June 15(6), 16(2), 17(4 including flying young), 19(4), 21(3), 22(4), 23(3), 24(3), 25(12), 26(16 in one flock), 27(7), 28(7). West of Thessalon it apparently is scarce in summer if indeed present at all. Snyder (1942) did not list it and Warburton (1950) gave it winter status only at Sault Ste. Marie.

Telmatodytes palustris (Wilson), LONG-BILLED MARSH WREN

At Blind River, in a cattail marsh, three were observed on June 21. The species was noted by Chandler Robbins (MS.) on Manitoulin Island but was not encountered in the Sault Ste. Marie region by Snyder (1942) or Warburton (1950).

Toxostoma rufum rufum (Linnaeus), BROWN THRASHER

Observed in daily numbers varying from one to seven. Although not uncommon farther east at Bigwood (Baillie and Hope 1947) it apparently is scarce westward in the Sault Ste Marie region according to Snyder (1942) and Warburton (1950). Specimens: 2 ad. males, 2 ad. females, June 16-22. Iron Bridge.

Hylocichla mustelina (Gmelin), WOOD THRUSH

Observed near Iron Bridge on June 14(4), 20(2), 24(2), 25(5), 27(2), 28(2); also 20 miles north of Thessalon June 20(2); 15 miles north of Iron Bridge June 17(2); and 10 miles north of Blind River (2).

Although this thrush has been recorded at Lake Nipissing farther east (Ricker and Clarke 1939), it was not found in the Sault Ste. Marie region by Snyder (1942) or Warburton (1950). Probably it is a recent arrival at Iron

Bridge. Specimens: 2 ad. males, June 20-21, Iron Bridge (10 and 13 miles N.).

Regulus calendula calendula (Linnaeus), RUBY-CROWNED KINGLET

A singing male in pine-spruce woodland, some six miles northwest of Iron Bridge, on June 23 was our only record. It behaved as though on its nesting grounds. It was not encountered by Snyder (1942) in the Sault Ste. Marie region and Warburton (1950) found it there only as an autumn migrant.

Specimen: 1 ad. male, June 23, Iron Bridge (6 miles N.W.).

Vireo gilvus (Vieillot), WARBLING VIREO

A singing individual in shade trees within the town of Blind River on June 21 was our only record.

Dendroica tigrina (Gmelin), CAPE MAY WARBLER

Two singing individuals in tall sprucepine forest ten miles north of Iron Bridge on June 24.

Specimen: 1 ad. male, June 24, Iron Bridge (10 miles N.).

Icterus galbula (Linnaeus), BALTIMORE ORIOLE

A group of two adults, accompanied by three flying young were observed 8 miles north of Blind River on June 21; also two other adults in the same general area. One adult male was noted on several occasions at Iron Bridge. Evidently this species is virtually absent as a breeding bird in the Sault Ste. Marie region for Snyder (1942) does not mention it and Warburton (1950) observed only one spring migrant.

Specimen: 1 ad. female, June 21, Blind River (8 miles N.).

Euphagus cyanocephalus (Wagler), BREWER'S BLACKBIRD

This western species is a very recent arrival in the region. Its presence at Sault Ste. Marie was first detected in 1953 and it was first ascertained to be nesting there in 1954 (Baillie 1954; Devitt 1964).

In 1966, we observed it regularly in daily numbers varying from 2 to 30 in the Iron Bridge, Blind River, and Thessalon areas. Short-tailed young, not long out of the nest, were noted near Iron Bridge.

Specimens: 2 ad. females, June 27, Sowerby (4 miles W.).

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Vertical Distribution of White Perch, *Roccus americanus*, modified by Light

DURING the summer of 1967, an attempt was made to record the diel vertical distribution of white perch in the Bay of Quinte, Lake Ontario. A bottom trawl operated both during the day and night, proved unsuitable. A specially constructed 18 foot deep gill net with panels of 1.5; 2; 2.5 and 3 inch mesh distributed at all depths was impractical because few white perch were taken and the net was choked with alewives (*Pomolabus pseudoharengus*). Windermere traps operated off the dock of the Fisheries Station at Glenora gave the best information. Previous experience had indicated that white perch were abundant here during the month of July.

Each trap was 4′ long and 2′ in diameter. On one side, there was an opening tapering to 4″ and on the other a door for removal of fish. The traps were made of ½″ wire gauze or nylon

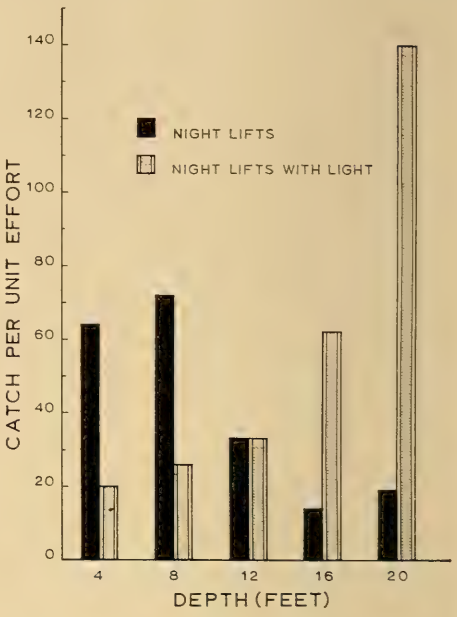

FIGURE 1. The number of white perch taken at the depths indicated per 100 hours night fishing per Windermere trap under normal conditions and with surface illumination.

TABLE 1.—Numbers of white perch caught at various depths in Windermere traps during July in the Bay of Quinte, Lake Ontario
(catch per unit effort in parenthesis)

Type of Lift	No.	Hours fishing	Number of fish and CUE at each depth (depths in feet)				
			4	8	12	16	20
Day	10	86	– –	1 (1.1)	– –	3 (3.4)	– –
Night	15	248	159 (64.1)	181 (72.9)	82 (33.0)	35 (14.1)	48 (19.3)
24-hour	10	240	52 (21.6)	88 (36.6)	33 (13.7)	27 (11.2)	40 (16.6)
Total of day, night and 24-hour	35	574	211 (36.7)	272 (47.3)	115 (20.0)	63 (10.9)	88 (15.3)
Night, surface illumination	8	112	23 (20.5)	30 (26.7)	37 (33.1)	64 (57.1)	157 (140.1)

mesh. Traps were hung at depths of 4′, 8′, 12′, 16′ and 20′. Observations were made between 8 July and 31 July. Thirty-five lifts, each involving 5 traps hung at the depths stated, were made. This involved 574 hours fishing. In addition, 8 night lifts were made to determine the effect of light. This involved 112 hours fishing while the surface of the water was illuminated by a 100 watt bulb.

Under natural conditions, there were 10 day lifts, 15 night lifts and 10 24-hour lifts; these involved 86, 248 and 240 hours fishing respectively. In all, 749 fish were collected. The catch per unit effort, defined as the number of fish caught per Windermere trap per 100 hours of fishing, was relatively low in day lifts. Results from night lifts and 24 hour lifts show that the CUE was maximum at 8 feet and then decreased in the depth order of 4′ ,12′, 20′ and 16′ (Table 1). Even combining all lifts, this pattern persisted. The day lifts caught too few fish to provide information on depth distribution. At night, the effectiveness of traps hung at 8′ indicated that the fish congregated near to the surface.

Analysis of night lifts made when the surface of the water was illuminated showed a different distribution. The CUE was maximum at 20′ and decreased from 140.1 at that depth to 20.5 at 4′ (Table 1 and Fig. 1).

Light had modified the vertical distribution of this population of white perch and it is undoubtedly important in controlling the vertical movements of white perch in nature.

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Striped Mullet, *Mugil cephalus*, Records from Halifax County, Nova Scotia, in 1966 and 1968

On the night of September 1, 1966, a small school of young gaspereau, *Alosa pseudopharengus* Wilson, was seen in shallow water, at the head of Prospect Bay approximately 14 miles south west of Halifax. Mixed with this school was a smaller number of striped mullets, *Mugil cephalus* Linnaeus. The mullets were smaller and seemed to be concentrated at the end of the school. There is some fresh water influence here from Whites Lake Brook and several small creeks. Out from the low tide mark there is thick eel grass and the sandy bottom becomes covered with deep silt.

Two mullets were collected with the use of a head lamp and a fine mesh landing net. This is the second recorded collection of *M. cephalus* in inshore Canadian waters. The two Prospect specimens measured 29 mm. and 31 mm. The first recorded collection of this species was by Vladykov when a three inch *M. cephalus* was taken in a seine haul in Bedford Basin, Halifax Harbour, Nova Scotia, September 29, 1931.

The Prospect area was visited again at night, on September 6, 1966, and three small schools of mixed mullets and gaspereau were seen. Five of the striped mullets were collected. Two of these specimens were deposited in the Royal Ontario Museum, Toronto. The catalogue no. is 25177.

1966

Date	No. of Specimens	Size Range	Average Size
September 1	2 specimens	29 mm. — 31 mm.	30 mm.
September 6	6 speciemns	29.5 mm. — 37.5 mm.	32.7 mm.
September 10	57 specimens	28.5 mm. — 37.5 mm.	31.7 mm.

1968

Date	No. of Specimens	Size Range	Average Size
September 24	7 specimens	32 mm. — 38.5 mm.	34.2 mm.
September 29	11 specimens	29 mm. — 48 mm.	38.3 mm.
October 1	2 specimens	30 mm. — 32.5 mm.	31.3 mm.
October 8	16 specimens	30.5 mm. — 58.5 mm.	39.3 mm.
October 12	10 specimens	32.5 mm. — 50 mm.	42.8 mm.
October 17	2 specimens	34.5 mm. — 42 mm.	38.3 mm.
October 22	14 specimens	33.5 mm. — 68 mm.	48.7 mm.
October 28	14 specimens	43 mm. — 76 mm.	52.8 mm.
October 29	1 specimen	48 mm.	48 mm.

The largest number of *M. cephalus* (approximately 200 to 300 mullets) was seen on the night of September 10, 1966. Some of these mullets were in small schools with gaspereau, however, most were scattered along the shore from the tide mark to a depth of about 2 feet. Fifty-seven specimens were collected.

I returned to the area at night on September 26, 1966, and saw one mullet swimming on its side near the surface.

No attempt was made to collect *M. cephalus* in the fall of 1967.

The small sandy beach at Prospect Bay was visited nine times between September 24 and October 29, 1968. Each time striped mullets were collected. At low tide slimy brown algae could be seen in the eel grass and on the bottom. Mullets were scooped up with the algae since they lay on top or were entangled within the plant life. The largest number of fish, approximately 300 specimens, was seen on October 8, 12, 22 and 28, 1968. On October 29 only one specimen was collected out of seven striped mullets seen. No mullets were seen on several trips made in early November.

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Puccinellia ambigua Th. Sør., new to the Hudson Bay Region

Puccinellia ambigua Th. Sør., heretofore known only from a few disjunct stations in the Gulf of St. Lawrence Region, has been added to the long and still growing list of bicentric littoral species common to the Hudson-James Bay area and the Gulf region, but lacking along the intervening Labrador coast. By its long, flagelliform and leafy runners, *P. ambigua* superficially resembles *P. phryganodes*, with which it has been confused but, unlike the latter, its anthers are fully functional but only half as long as those of *P. phryganodes*, and it regularly produces normal and viable fruits.

Puccinellia ambigua was described and illustrated in Medd. o. Grl. 136,3:64 (1953), tab. 7, and figs. 1, 37 and 83-84. The type came from Prince Edward Island, Prince Co., Alberton, and was collected by M. L. Fernald & H. St. John, No. 6913. Duplicates had been distributed to several herbaria by Fernald and labelled *P. paupercula* (Holm) Fern. & Weatherby var. *alaskana* (Scribn. & Merr.) Fern & Weatherby, with the parenthetic comment "dwarf form with abundant long stolons resembling those of *P. phryganodes*". The type of *P. ambigua* is in Copenhagen and a duplicate in Ottawa (CAN 37617). Besides the type Sørensen (l.c.) cited a specimen from the Avalon Peninsula, Newfoundland, Fernald & Wiegand, No. 4656, of which a duplicate likewise is in Ottawa, and a third, from New Brunswick: Gloucester Co. Grande Anse, Tureson & Alm, No. 164. Additional specimens in the National Herbarium, Ottawa, by Fernald & Weatherby (1916) cited either as *P. paupercula* or *P. paupercula* var. *alaskana*, suggest that *P. ambigua* is wideranging in the Gulf of St. Lawrence region: Newfoundland: Valley of Exploits River, Norris Arm, Fernald & Wiegand, No. 4657; Region of Bay St. George, damp sandy shores, St. George, Fernald & Wiegand, No. 2614; Magdalen Islands: wet brackish sand, Grindstone Island, Fernald, Bartram, Long & St. John, No. 6912; Saguenay Co., Quebec, Bluff Harbour, 50° 12′ N. and 60° 41′ W., Aug. 1, 1927, Harrison F. Lewis; and Gaspé Co. Que. Salt Marsh, Rivière St. Anne des Monts, Tourelle, Fernald & Smith, No. 25441.

Sørensen (l.c.), placed *P. ambigua* in what he called the "Pumilla Group", said to be "best typified by *P. pumila* (Vasey) Hitchc. and by *P. kamtschatica* var. *sublaevis* Holmb., both of them natives of the subarctic Beringian Region. Generally low-grown, glaucous and glabrous caespitose plants, by rare exceptions forming epiterranean runners. Spikelets and pedicels somewhat shining, bracts [glumes] entire or nearly so, not markedly nerved. Epidermal cells ± warty, the short cells often semiglobular, tumid, sometimes transformed into minute blunt spinules; marginal cells rather short, though generally not isodiametrical".

Besides the above, Sørensen included the following in his "Pumila Group": *P. triflora* Swallen and probably *P. Hultenii* Swallen, both of Alaska, and *P. pumila* var. *Fernaldii* Hultén, which latter is *P. paupercula* var. *alaskana* sensu Fernald & Wiegand of the Gulf of St. Lawrence region or, at least all those that have stolons. Sørensen further suggested that *P. kamtschatica* var. *aspera* Holmb. of eastern Asia, and the Novaya Zemlian *P. tenella* (Lange) Th. Sør. may belong. The Pumila group is arctic- subarctic but, according to Sørensen, is not represented in floras of Greenland, or Spitsbergen. In fact true *P. pumlia* may not be present either in the flora of eastern North America.

Sørensen (l.c. p. 66) further showed that *P. paupercula* var. *alaskana* of Fernald and Weatherby consists of two elements: one distinguished by flagelliform runners, superficially resembling those of *P. phryganodes*, and known to him only from the Gulf of St. Lawrence Region, he separated and described as

P. ambigua. The non-stoloniferous *P. paupercula* and *P. paupercula* var. *alaskana* of the Gray Manual range, according to Sørensen are related to *P. pumila*, but without a legitimate name, because *P. pumila* var. *Fernaldii* Hultén, 1937, p. 96, was based on *P. paupercula* var. *alaskana* (sensu Fernald and Weatherby) as illustrated in Rhodora 18:18 where the illustrations: tab. 117 and figs. 68-72, unfortunately, were drawn from a specimen from British Columbia.

When dealing with the genus *Puccinellia* for a Flora of Continental Northwest Territories (in preparation, see Porsild & Cody, 1968) we hesitated to include *P. pumila* in view of Sørensen's cautioning conclusions. In the National Herbarium of Canada, however, are four sheets of *Puccinellia* from the Hudson Bay region, that by Sørensen were tentatively referred to *P. pumila*. He saw these in 1953, but only after his monograph had gone to press. One, from Rankin Inlet on the west coast of Hudson Bay, lat 62° 45′, Aug. 30, 1910, J. M. Macoun, CAN 79116, by Fernald and Weatherby determined as *P. paupercula*, he annotated *P. pumila* (Vasey) Hitchc., and the remaining three: *P. alaskana* Scribn. & Merr., from Churchill, Man. Aug. 13-16, 1936, N. Polunin, No. 1917; *P. angustata* R. Br. from east coast of Hudson Bay, Long Island, 54° 36′, Dutilly & Lepage, No. 12,789; and *P. arctica* Hook. from the east coast of James Bay, Attikuan Pt., 54° 12′ N., Baldwin, Hustich et al., No. 187, Sørensen tentatively named *P. pumila* (Vasey) Hitchc. s. lat.

An examination of much new material in the National Herbarium of Canada of *Puccinellia* from the eastern Canadian Arctic, accessioned since 1953, brought to light, under *P. phryganodes*, two collections of clear-cut *P. ambigua* Th. Sør.: East coast of James Bay, déprimé sur le rivage de sable, Vieux-Comptoir, 52° 37′ N., 78° 42′ W., 31 Juil, 1954 Dutilly and Duman, No. 32.096; vicinity of Churchill, Man. 58° 46′ N. 94° 10′ W., wet area in salt marsh, July 30, 1956, Schofield & Crum, No. 7088. Both have well developed leafy runners and in both the florets are fertile and the anthers 0.6-0.7 mm long.

Inasmuch as the range of *P. ambigua* has thus been extended to the Hudson Bay region, there is perhaps reason to suspect that the Rankin Inlet specimen, and certainly the remaining three that Sørensen hesitated to consider typical *P. humilis* may, in fact, be *P. ambigua*. The Rankin Inlets specimens unfortunately were collected very late in the season, when most of the florets had been reduced to empty glumes, and when the bases of the flowering shoots were shrivelled and partly reduced to shreds. If not *P. ambigua*, the Rankin Inlet plant is probably identical with the non- stoloniferous *P.* "*paupercula*" of the Gulf of St. Lawrence region type. In the James Bay specimens (Baldwin & Hustich No. 187) leafy runners are already sprouting on July 20, and in Dutilly and Lepage's, No. 12,789, insipient internodal rejuvenation buds, such as are illustrated by Sørensen (l.c. fig. 1, on p. 66) for *P. ambigua*, can be seen quite clearly.

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Red-tailed Hawks Nesting on Cliffs in Ontario

THE Red-tailed Hawk, *Buteo jamaicensis*, is known to nest occasionally on cliffs in western North America, but apparently very few such nestings in the eastern part of the continent have been mentioned in the literature. Snyder (1942) describes a cliff nest in the Sault Ste. Marie region: "A pair of Red-tailed Hawks reared its family in a nest situated on a ledge high up on the rock cliffs at Iron River. The nest, from very close inspection, appeared as characteristically bulky as one built in a normal arboreal site." MacLulich (1938), referring to Algonquin Provincial Park, did not mention a specific nest but stated that "It builds its nest either in tall trees in the forest or near the top of a high rocky hill or cliff." Since these are the only published references that I have been able to locate on this species' cliff nesting in eastern North America, I think that the following accounts of two such nests are of interest.

Dr. George K. Peck, of Oakville, Ontario, supplied me with information about a nest on a cliff at Mount Nemo (part of the Niagara Escarpment), Halton County, Ontario. He described it as being on a small ledge and supported by a small cedar tree growing out of the rock, about 25 feet down from the top of the cliff and 125 feet up from the base. He observed this nest on May 1, 1965, when it contained two small young, and again on June 2, 1968, when it held two eggs and the adult was incubating. A report came to him later that these eggs hatched and subsequently one young disappeared. Dr. Peck also said that he has good reason to believe that this nest was similarly occupied in 1964. In 1966 and 1967 it was not used and this pair of Red-tails was thought to be nesting in a tree in the valley.

Another Red-tailed Hawk cliff nest was discovered by the writer and Joseph F. Thill on April 12, 1968, on the west side of the Niagara River gorge about 1.5 miles south of Queenston, Ontario. This large nest is located about 18 feet below the cliff top and approximately 280 feet above the river. It is placed against a sheer but irregular face of dolomite rock strata and appears to be partly on a small ledge but chiefly supported by a small cedar tree growing from the rock. At the time of discovery the female was apparently incubating, and during this observation period the male alighted once on the nest but mainly soared about the gorge or perched on trees growing from its sides. On May 7 two downy young were in the nest and they began to feed on a rodent which an adult brought in. By May 21 the young were well feathered and frequently exercised their wings. On this date and on June 3 an adult was seen to tear up food and feed the young. On the latter date only one almost full grown young bird was on the nest. It frequently moved about and flapped its wings as if in preparation for a first flight attempt. I thank Dr. Peck for the data on the Mount Nemo nest and also for checking some of the literature not immediately available to me.

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Clethraceae: A Plant Family New to Canada

SWEET PEPPERBUSH or white alder, *Clethra alnifolia* L., is a shrub 1-10 feet high of the coastal plain of eastern North America.

This note reports for the first time the occurrence of this species in Canada, thus adding a new family: *Clethraceae*, to our flora.

I collected specimens of this plant growing on the shore of Belliveau Lake, Belliveau Cove, Digby county, Nova Scotia on October 13, 1968. The shrub, about 5 feet high, was in flower at this time with numerous racemes of distinctly fragrant, white blossoms. A colleague later found the species in several places around the same lake.

Clethra alnifolia occurs from eastern Texas to Florida north to southern Maine, southern New Hampshire, southeastern New York and eastern Pennsylvania. (Fernald, 1950). It is found in Cape Cod and on the Elizabeth Islands, Massachusetts, where it is one of the more conspicuous bog plants and is characteristic of the dense shrubby thickets about pond borders and in the transition zone between grassland and woodland. (Fogg, 1930).

The distribution of *Clethra alnifolia* follows that of a number of coastal plain species which occur in southwestern Nova Scotia, and on the mainland range from southern Maine to Florida and Texas near the coast. Roland (1945) lists thirty-one species as typical of plants showing this pattern of distribution. Three outstanding examples from this group are: *Ilex glabra* (L.) Gray, *Lachnanthes tinctoria* (Walt.) Ell., and *Lophiola septentrionalis* Fern. Southwestern Nova Scotia has still a number of unbotanized lake shores and stream edges likely to yield additional new records of species which here at their northern limits are rare and often highly localized.

There are several reasons why a species as large and conspicuous as *Clethra alnifolia* has not been reported before this:

1. Despite the Gray Herbarium Expedition to Nova Scotia and the extensive work of A. E. Roland, J. S. Erskine and E. C. Smith, many lake shores and stream edges in southwestern Nova Scotia remain to be botanically explored.
2. When not in flower, *Clethra* superficially resembles *Ilex verticillata*, a very common shrub in the Province.
3. When *Clethra* is in flower and conspicuous, from late September to October, most botanists have returned to the office and lecture hall.

My specimens (*Taschereau* 373) have been deposited in the following herbaria: Acadia University, Wolfville, N.S.; Nova Scotia Museum, Halifax; Plant Research Institute, Canada Department of Agriculture, Ottawa.

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Accepted February 10, 1969

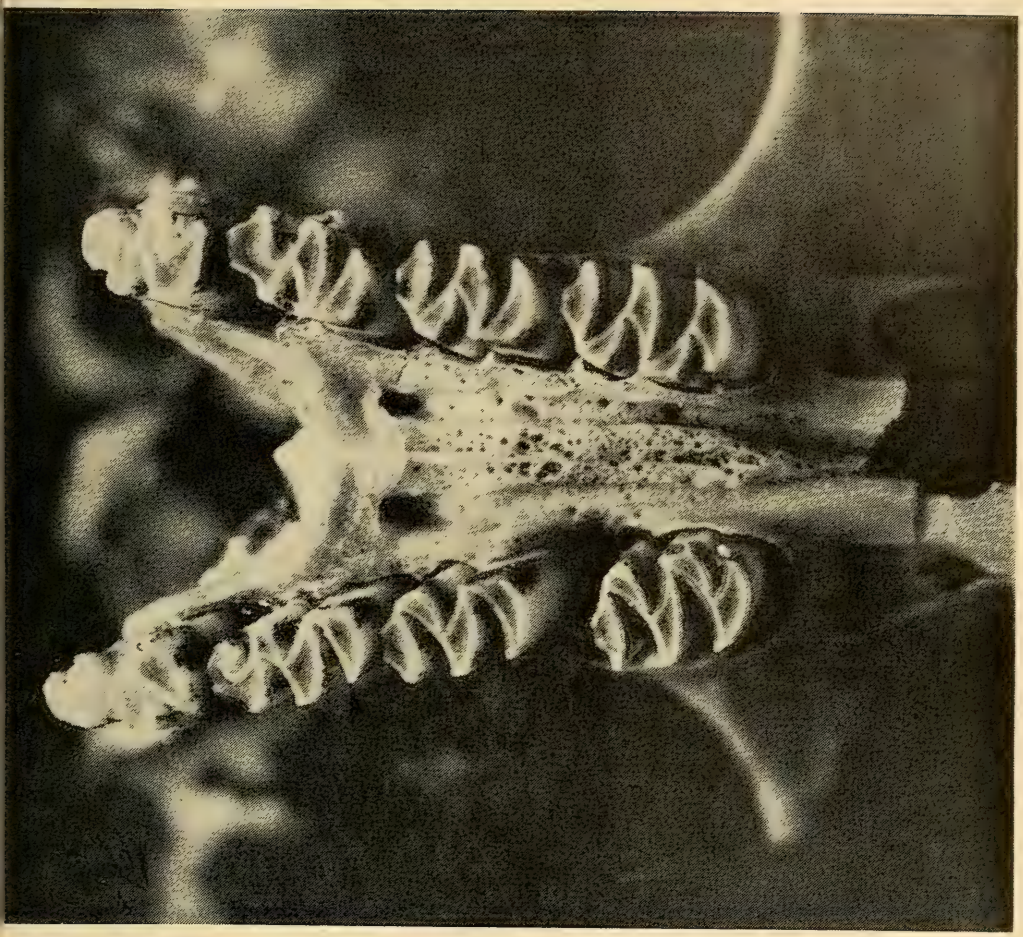

FIGURE 1. Arrangement and occlusal pattern of supernumerary teeth in an abnormal maxillary of a brown lemming from Barrow, Alaska.

Supernumerary Teeth in a Brown Lemming from Barrow, Alaska

IN MATERIAL collected at a white fox (*Alopex lagopus*) den site 25 km southeast of Barrow Village, Alaska, was an unusual brown lemming (*Lemmus trimucronatus*) maxillary. It contained four rather than the three cheek teeth characteristic of this species (Fig. 1). Also, the left and right enamel patterns of the occlusal surface differ markedly from each other. The right tooth row, 9.2 mm long, contains a normal set of molars plus an additional one that duplicates the enamel pattern of the normal M_3. The left tooth row, 10 mm long, contains a normal M_1 and M_2 but the M_3 enamel pattern copies that of M_2. The extra molar is compressed and lacks the characteristic distal hook found in the normal M_3 structure.

This skull, U.A. No. 7840, is deposited in the biological collections section of

the Museum, University of Alaska, College, Alaska.

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Studies of the Byron Bog in Southwestern Ontario XXXVII. Leeches (Hirudinea) Collected in the Bog

IN 1961 regular daily collections of invertebrates were made from May 8 to September 29 in the four different zones of the Byron Bog. These four zones were wooded slopes (C), lower wooded region (B), open floating bog (A) and the open pond, Redmond's Pond (D) (Fig 1, Judd, 1963). Collections were made by M. S. Beverley following the procedure described by Judd (1963). Among the aquatic invertebrates were fifteen leeches which have been identified by Dr. J. E. Moore, Box 307, Edmonton, Alberta, as *Erpobdeila punctata* (Leidy) (Erpobdellidae) and *Theromyzon* sp. (Glossiphoniidae). The distribution of the specimens in the zones of the bog was as follows, one specimen for each date:

Zone B

E. punctata—May 26, June 22, July 18

Zone C

E. punctata—June 30, July 30

Zone D

E. punctata—May 20, June 13, 17, 29 (immature), 30, July 14 (immature), 15

Theromyzon sp.—June 26, July 15, 16

Leeches of the genus *Theromyzon* were found only in Redmond's Pond (Zone D). This pond is frequented by swimming birds and the presence of leeches of this genus in the pond is in accord with the report of Mann (1962) that most species of *Theromyzon* enter the nostrils of wading and swimming birds and feed from the mucous membrane.

Mann (1962) reports that among leeches of the family Erpobdellidae some are aquatic, devouring freshwater invertebrates, while others take up a burrowing existence at the edges of lakes and streams, or occasionally become fully terrestrial, devouring earthworms. Specimens of *Erpobdella punctata* in the bog were found in this range of habitats, for while most of them were collected from Redmond's Pond in Zone D, some were in the temporary pools under trees in Zone B and two were in muddy patches on the lower slopes of Zone C. Pennak (1953) records that *E. punctata* feeds on aquatic invertebrates, fish and frogs and is sometimes a scavenger, and Judd (1968) found *E. punctata* in dead crayfish in the vicinity of London.

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NEWS AND COMMENT

A National Park for the Northwest Territories — The East Arm of Great Slave Lake and Artillery Lake

Since 1962 the subject of establishing the first National Park wholly in the Northwest Territories has been under study. The reasons for proposing a park in such a remote region as the east end of Great Slave Lake are manifold, but the problems involved are also numerous.

On 19 February, 1969 a public meeting regarding this proposal was held in Edmonton, Alberta. An overwhelming majority of the 102 people present were in favour of such a park. At that time no map of the projected site was available. However, it was known that the Parks Branch of the Department of Indian Affairs and Northern Development (DIAND) had proposed a "core" National Park of 1100 square miles with a "National Park Reserve" which would eventually increase the park area to 4300 square miles. The total reserve area would be added after a period of mineral exploration. At the meeting, various people who are familiar with the area gave informative talks and provided a short information sheet. Several days after the meeting a 17-page bulletin from the National Parks Branch of DIAND was received. Most of the material presented below was derived from this bulletin and the information sheet.

The DIAND bulletin describes the area thus: "Nowhere else is the treeline-tundra transition represented in such a dramatic manner. The scenic splendour is striking; green waters contrasting with red cliffs, waterfalls thundering into the gorges . . .". The entrance to the East Arm of Great Slave Lake is choked with a myriad of low, smoothly-contoured islands of Precambrian rock capped by stands of wind-sculpured black-spruce. To the east the islands grade into more rugged outlines, culminating in the vertical cliffs of awesome proportions on Redcliff and Et-Then Islands. Similar cliffs jut from the lake on mainland peninsulas and headlands.

The deepest body of fresh water in North America is in Christie Bay, the southern part of the East Arm. Here the water is over 2000 feet deep, and from above looks crystal-clear for almost 100 feet.

The geology of the region is responsible for the magnificent scenery. The most significant feature is the McDonald fault. This huge downfault in the earth's crust has given rise to a Graben comparable to that of the Red Sea or the Rhine Valley. It is responsible for the towering cliffs and the depth of the basin in which Great Slave Lake lies. Some of the oldest rocks on the surface of the earth form the country to the north. They are part of the Precambrian Shield and are between 2500 and 2600 million years old. This section of the Canadian Shield slopes steeply from 1200 feet elevation to the bottom of the lake, which itself is overlain by sedimentary and volcanic rocks. The immense reddish cliffs are composed of resistant diabase sills.

The McDonald fault, on the south shore of the lake, is an extremely well defined landmark. It extends about 350 miles from the Slave River to the Thelon River. In places it presents a straight wall of rock, sometimes over 700 feet high. To the east the fault is expressed as a trough, and associated with this are numerous small lakes and interconnecting streams known as Pike's Portage Route.

To the south of the fault the land rises in rolling country at about 1000 feet elevation. Here the rocks are younger, aged 1800 to 1900 million years.

The resistant nature of these rocks makes the streams flowing into the lake brilliantly clear. The rapid descent on the north shore makes the waters flow in white torrents over rapids and waterfalls from the small lakes above the rim of the

East Arm. The Lockhart River drains Artillery Lake into Great Slave. In falling 700 feet in 20 miles it surges over countless rapids and four waterfalls – Hanbury, Anderson, Perry, and Tyrell.

The river water lacks dissolved minerals and organic matter. This makes the lake waters almost alga free and transparent to such considerable depths. Such lakes are termed oligotrophic and represent the earliest stage in the transition of lakes to marshes, and eventually dry land. Nevertheless, there is aquatic life. There are populations of sport-fish such as Grayling, Whitefish, Pike, and Lake Trout, as well as other fish. Lake Trout breed predominantly in the East Arm.

A spectacular array of birds feed upon these fish. They include Arctic Loons, Grebes, Mergansers, Arctic Terns, Gulls, Cranes, and Bald Eagles. Great Slave Lake is one of the major breeding areas for the fast diminishing population of Bald Eagles. There are many Passerines inhabiting the forest; ducks and geese breed in the area.

The northern Boreal forest supports a contingent of characteristic small mammals. These are chipmunks, squirrels, marmots, flying squirrels, jumping mice, shrews, voles, and deer mice. Some of these fall prey to foxes or supplement the diets of wolves. Among the larger animals which are fairly common are moose, black bears, and caribou. The migration route of the caribou is close to Artillery Lake. The tracks of all these animals pock-mark the gravelly beaches of the lakes.

The theme of this National Park would be "Edge of the Barrens". One of the best known transitions from taiga to tundra is well delineated around Artillery Lake. The country grades from black-spruce forests to open lichen-woodlands and on to the barrens of the low arctic tundra. During the short summer the tundra flowers burst into a mass of vivid colour, typified by yellow mountain avens, red-purple fireweed, blue lupins, and a multitude of other blooms, busy with bumblebees and flies.

Ptarmigan thrive on the abundant food of the tundra, along with hares, lemmings, and other tundra animals. Here the caribou find summer fodder and wolves lope in search of prey. Occasionally the rare barrenground grizzly bear may venture into this region.

Eskers occur over the tundra as reminders of the receeded icesheets of the last great glaciation. They break the homogeneity of the arctic barrens as distinctive serpentine landmarks.

The tundra-taiga transition zone has not been studied in detail. Much can be learned about plant and animal communities in general from an examination of the ecosystems associated with such an extensive and important ecotone.

History has its fair share of adventure to relate. Many famous northern explorers have their names linked with the areas around Great Slave Lake. Samuel Hearne and Alexander Mackenzie reached Great Slave Lake in the late eighteenth century. Captain Back established Fort Reliance at the mouth of the Lockhart River in 1833 on his scientific exploration in connection with assisting John Ross' arctic expedition. The ruins of Fort Reliance still stand as three disintegrating chimneys. The Back River was named for Captain Back and is associated with some of the searches for the lost Franklin expedition. John Hornby explored these regions, and died after immeasureable hardships in what is now the Thelon Game Sanctuary. In the 1880's Warburton Pike travelled in the area and left his name on Pike's Portage Route. Geological exploration started with Dawson and Tyrell in the late nineteenth century. Other famous names associated with Great Slave Lake are Mackinley, Bullock, Preble, and Ernest Thompson Seton.

The area presents us with a convergence of numerous unique features. Geographically, the lake itself with its depth and clarity, and the McDonald fault with its

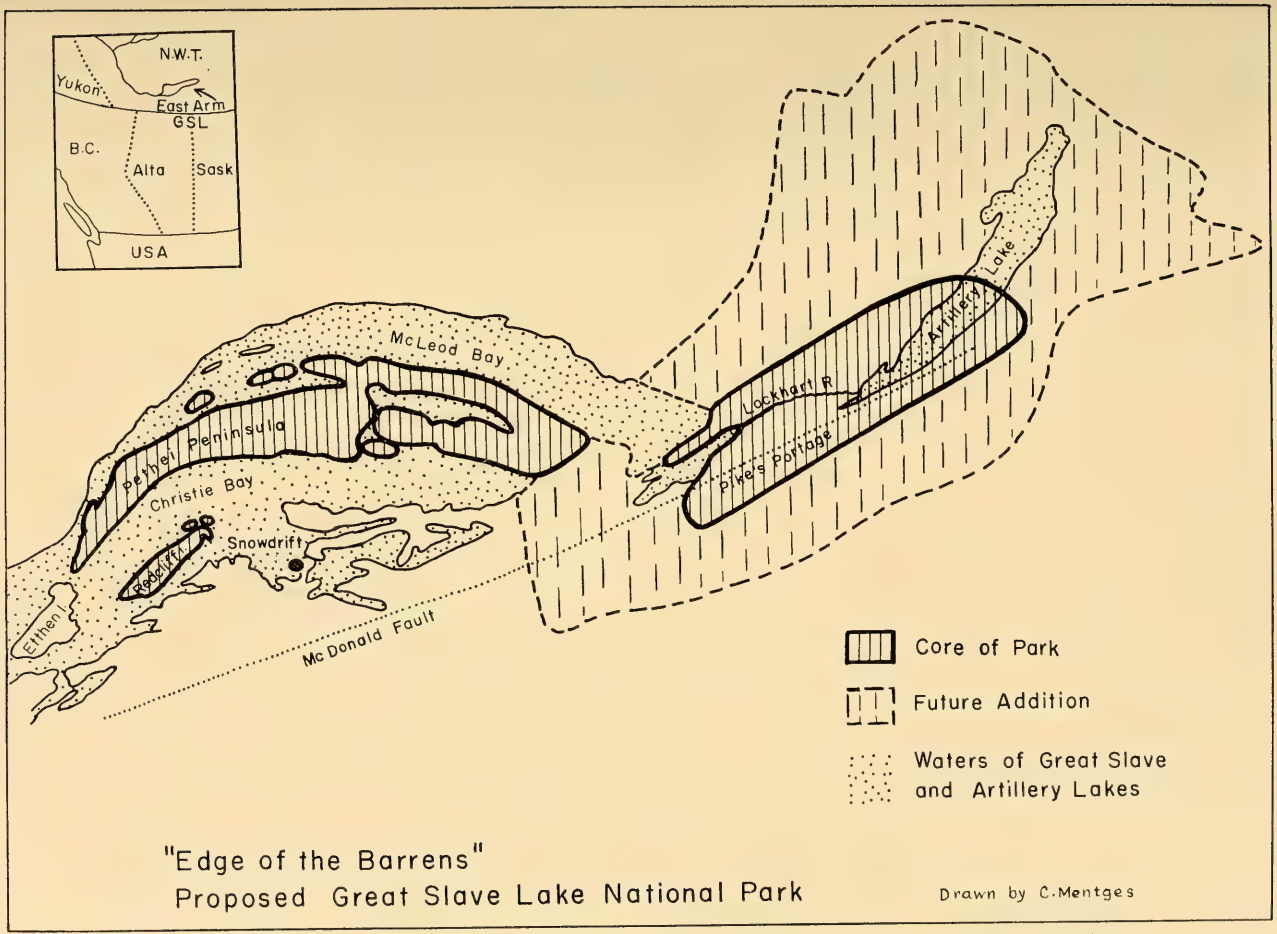

FIGURE 1. Park area as proposed by Parks Branch of the Department of Indian Affairs and Northern Development.

ancient rocks effect the spectacular scenery. Climatologically, the area is 'Boreal interior' and is not represented in any other existing park. Historical interests will be preserved. The theme "Edge of the Barrens" is well represented by the animal and plant communities on each side of the treeline gate. Clearly, here is an area of intense interest to all students of natural history at every level.

The objections to establishing a park in this area are mainly commercial. Certainly, such a park will not be accessible to the majority of Canadians at present. It will be the only National Park wholly in the Northwest Territories, and the only Canadian National Park established about a large body of water. It will preserve for future Canadians a combination of unique and beautiful inheritances, protected, pristine, and unpolluted.

Commercial ventures in the area include fishing. A park would improve the lot of the Indian people by enabling them to sell their experience with the waters and the woods as guides to fishermen. The fishing rights of the Indian people should not be jeopardized by the inclusion of part of the East Arm within the park.

The major economic concerns come from mining enterprises. These have a very strong influence on activity in the area. Associated with the McDonald fault, responsible for much of the scenery, are such rich mineral deposits as the finds at Pine Point on the southern shore of the lake. Naturally, mining interests do not want to unconditionally surrender the opportunity to exploit mineral resources which may be present on the fault at the East Arm.

Extraction of ore would be from shaft mines which occupy relatively small areas. With stringent regulations on the area of above-ground workings and pollution of the atmosphere and the lake by dust, smoke, sewerage, and noise, a compromise between conservation and exploitation could probably be reached for the 'reserve area'.

The map presented here (Figure 1) has been redrawn from the DIAND bulletin. The obvious fault with the proposed park and reserve area is that no water of the East Arm is included within the boundaries. The majority of the spectacular parts of the McDonald fault are also missing. The reserve area should encompass more of the McDonald fault south and west of the town of Snowdrift, Et-Then Island, and the north shore of the East Arm if this park is to be complete.

Another shortcoming of the DIAND proposal is the lack of regulations on mineral exploration and exploitation. A 10-year period for exploration should be adequate. Regulations on all mining activities must consider extraction methods, and the transportation of the ores in relation to the whole park and pollution of the environment, particularly the lake.

A set of regulations, settled on by arbitration in the very near future, would ease the doubts of both the park supporters and the mining concerns. Above all, we must not be deterred by difficult opposition from striving to work out some agreement which will ensure the permanent integrity of this outstanding area. In this regard we urge you (the reader) to support this park at the "Edge of the Barrens" by letters to the Department of Indian Affairs and Northern Development and the press.

P. G. KEVAN,
Department of Entomology,
University of Alberta, Edmonton.
L. N. EVERNDEN,
Department of Zoology,
University of Alberta, Edmonton.
April 14, 1969.

PESTICIDE CAUSING RAPID EXTINCTION OF THE BROWN PELICAN

CALIFORNIA'S famous pelicans, those swift-diving, gape-peaked fishing birds so familiar all along our coasts, are facing total extinction from poisonous DDT that rains like fallout into their ocean feeding grounds.

It looks as though the huge brown birds will hatch no young at all in California this year, and the path of death is sweeping inexorably southward as far as the Mexican islands off Baja California.

The DDT, a long-lasting pesticide, used widely on the State's croplands, is entering the marine food web through tiny oceanic plants and animals known as plankton; small fishlike anchovies and sardines, eat the plankton, and the pelicans eat the fish. At each step along the way the DDT becomes more concentrated.

The doom of the pelican — and most probably of many other sea bird species as well – was disclosed yesterday by Dr. Robert W. Risebrough at the University of California's Institute of Marine Resources in Berkeley.

Dr. Risebrough and a group of colleagues have been surveying the pelicans' nesting sites on islands along the California coast for the past month. The result is grim indeed: this is the nesting and egg-laying season, but scarcely any eggs at all are surviving.

Why? Because the DDT residues accumulating in the bodies of the adult female birds upsets an intricate hormone-enzyme relationship and cause the pelicans to lay thin-shelled eggs so deficient in calcium that they crack and fall apart almost at once. Even the ones that last a few days are so fragile that they cave in under the weight of the nesting mother's body.

The upshot is a new and inescapable assault by a powerful synthetic pesticide on still another of the diverse living organisms with which man shares a delicate ecological balance.

Risebrough reported yesterday that a month ago he and a team of colleagues visited Anacapa, one of the Channel islands off Oxnard, in Ventura county. In the group were Joseph R. Jehl and M. N. Kirven of the San Diego Natural History Museum and Fred C. Sibley of the U.S. Fish and Wildlife Service at Ojai.

Anacapa is a major nesting ground for the huge brown pelicans, and Risebrough's team counted 298 new nests. But only twelve contained intact eggs; hundreds of broken, flaky, eggshells from the other nests littered the ground. Many still contained yolk material, and careful analysis in Risebrough's laboratory at Berkeley showed heavy concentrations of DDE – an altered DDT molecule – in the fatty parts of the yolk.

Careful measurement of the broken egg shells showed they averaged only .287 millimeters thick – about half the thickness of a similar group of pelican eggs collected in the same locality 30 years ago, when a thousand nests produced 2000 to 3000 eggs and young each year.

A week after Risebrough's first visit to Anacapa he returned, and found that all twelve of the intact eggs had been shattered. They were too thin to survive.

On April 18, he said, Sibley and James Keith of the Fish and Wildlife Service at Davis, California, returned again to Anacapa. This time they found 320 new pelican nests, and in only 19 were there any intact eggs at all. A pelican usually lays and hatches a clutch of two to three eggs; the few Anacapa nests with any eggs at all contained only one or two in each and they probably won't hatch either.

And yesterday came still another report: From San Diego Dr. Jehl told The Chronicle he has just spent a week exploring islands off Baja California. On Coronados, eight miles from Tijuana, he found only 19 intact eggs among more than 300 pelican nests; on San Martin, southwest of Ensenada, he found 17 unbroken

eggs among 100 nests; and on San Benito, 300 miles further south, he found the first sign of hope – 38 nests with a total of 66 intact eggs among a group of 73 nests in all.

Apparently the lethal pesticide residue in the ocean thins out further south and this is probably because so much more of it is used in California fields.

This fits in with Risebrough's observation that pesticide concentrations in the bodies of ocean fish are heavy near the California coast – and heaviest of all around Los Angeles, where the wind-borne DDT particles are trapped in the concentrated smog and drift downward to the sea surface.

One of the most dangerous features of DDT, aside from the fact that it persists as a poison for many years without breaking down, is that it does not dissolve in water, but does dissolve in fats.

Therefore the particles can be carried through the ocean waters, enter the bloodstream of fish and birds, and build up in their fatty tissues.

Many, many varieties of sea birds are now being affected by the toxic chemical. Petrels, murres and cormorants are endangered.

The bodies of California's ubiquitous seagulls contain DDT residues too, but Risebrough believes they're safe for the time being. The reason: much of their diet is garbage from populated areas, and as Risebrough says gloomily; "California garbage is probably cleaner than the ocean's fish today."

If the current pace of pesticide use continues, Risebrough warned yesterday, more and more of it will find its way to the sea; the outlook, he said, is for total extinction of many species of marine bird life.

As for man, no one can yet say. All fish contain DDT now, and man eats them in great quantity. What the long range human dangers may be, science has yet to find out.

DAVID PERLMAN (Science Correspondent)
San Francisco Chronicle
April 22, 1969
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SURVEY OF BIRD COLLECTIONS

THE SUBCOMMITTEE on Collections, of the Committee on Research of the American Ornithologists' Union, is conducting a survey of collections of birds in the United States and Canada. In the past, many studies utilizing museum materials have been handicapped by ignorance of the existence of potentially important specimens. We hope, by means of this survey, to enable future workers to take full advantage of all available material.

Survey forms have been sent to institutions and individuals known to have, or suspected of having, an ornithological collection. We request your assistance so that our survey will be as complete as possible.

If you have received a survey form, please complete it and return it promptly. If you have a collection and have not received a form, or if you know of other persons or institutions who have collections but who have not received a form, please notify:

RICHARD C. BANKS,
Bird and Mammal Laboratories,
U.S. National Museum,
Washington, D.C., 20560

LOUISE DE KIRILINE LAWRENCE IS HONORED

THE author of a recent book *The Lovely and the Wild* published by the McGraw-Hill Book Company, has been awarded the John Burroughs Medal for her writing on nature. Mrs. Lawrence, is a Canadian who lives with her husband on the banks of the Mattawa River west of Mattawa, Ontario. The medal was presented by the John Burroughs Memorial Foundation at a ceremony at the American Museum of Natural History, New York, in March. Mrs. Lawrence is the 43rd winner of the medal. "The Lovely and the Wild" is reviewed in the January-March, 1969 issue of the Canadian Field-Naturalist.

LETTERS

NATIONAL PARKS POLICY — DECISIONS WHERE CONFLICTS EXIST

THE FINANCIAL POST of February 15, 1969 contains a lead article on page 1 under the heading:

Federal Schizophrenia
Parks and Mines Vie for Beauty Spot

The article discusses the conflict of interest between the national parks and northern development responsibilities of the Department of Indian Affairs and Northern Development in the case of the proposed 4,300 square mile national park at the eastern end of Great Slave Lake (see map on page 171 of this issue). The conflicting interest is the suspected existence of rich mineral deposits which, together with hydro-electric potential, would support an important extension to the wealth of the Northwest Territories.

Pros and cons are given to state the case of the miners and the National Parks officials. What is of serious concern to naturalists, however, are the conclusions offered by the reporter who posed the following Questions:

"1) Are there other sites equally suitable for national parks?

2) If alternatives prove less desireable, what is the real measure of net gains and losses between the various alternatives and potential resource development?"

He then goes on to state "This is not a task which Ottawa can properly leave to the parks department. Its role basically is to find the best possible parks. It is too much to ask the parks department to decide between compromises." This is followed by a pitch for a new category of national parks which permit both resource development and parks use.

The important factors to naturalists are:

1) The parks officials have stated that other sites in the Northwest Territories were examined but that this was the outstanding one in terms of those features which the parks policy would like to preserve for future generations.

2) Most politicians are still far more impressed with arguments which emphasize economic considerations than those of an esthetic, cultural or other non-economic character.

3) The general public is only beginning to realize the cost that exploitation of natural resources imposes on the taxpayer in the form of
   a) Lost natural areas
   b) pollution of land, water and air, and
   c) the ecological imbalances which so often result.
4) Granted that joint resources and parks uses might be achieved if effective controls could be applied, the sad experience of most experiments of this nature should make the administrators extremely cautious. Past experience has shown that the mining industry, having as its objective the achievement of profits for its owners, has rarely, if ever, been content to exploit only a part of any desirable mineral occurrence. Getting the foot in the door is almost a certain prelude to having the camel (the mining interests) in the tent and the master (the general public) out in the cold. In case anyone should point complacently to the joint use of Algonquin Park by the public and the forest industry, two points might be made
   a) Forests are renewable resources whereas minerals are not.
   b) The forest industry has a great deal to gain in Algonquin Park by not "rocking the boat".

I would end by appealing to naturalists to be conservationists in this and like cases and use every possible means to convince their elected representatives that:

a) a change in parks policy is not in the best public interest, and
b) unique natural areas are precious resources, which, once destroyed are almost always irreplaceable.

HUE N. MACKENZIE,
President,
Ottawa Field-Naturalists' Club
March 27, 1969

REVIEWS

The World of the Wolf

By Russell J. Rutter and Douglas H. Pimlott, 1968. J. B. Lippincott Company, Philadelphia and New York. 202 pp. illustrated. $5.95 (U.S.).

This is another in the fine series of mammal biographies in the *Living World Books* edited by John K. Terres. This volume is authored by two Canadians. Russell Rutter is a long-time Ontario naturalist raised on a small farm near Burks Falls. After wartime service he worked in Algonquin Provincial Park as an Interpretive Naturalist. Douglas Pimlott studied wildlife biology and forestry after his wartime service and later joined the Ontario Department of Lands and Forests to study timber wolves in Algonquin Park. These two men are ably equipped to write of the "world of the wolf" based upon their extensive field studies in Algonquin Park.

Pimlott wrote the chapters on the wolf as a symbol of evil, the war on wolves, the wolf as an individual, the future of wolves and wolves around the world. He is also responsible for the many excellent photographs which profusely illustrate the text. Rutter wrote the chapters on the annual cycle of the wolf and the voice of the wolf.

This book relates mainly the observations and experiences of the authors with Algonquin Park wolves. Little attempt was made to integrate the many published wolf observations although David Mech's study of Isle Royale wolves is frequently mentioned. There is bibliography of 58 titles, but no mention of Mowat's *Never Cry Wolf*! The style is plain and straight-forward in description. This book will be of special interest to Ontario naturalists because of the emphasis placed on Algonquin Park wolves.

A. W. F. Banfield

National Museum of Natural Sciences, Ottawa

Palaeontology of the Swan Hills Area, North-Central Alberta

By Loris S. Russell. 1967. Royal Ontario Museum, Life Science Series, Contribution 71, 31 pp., 1 plate. Paperback. $1.00.

The Swan Hills of Alberta are located in the central region of the province, approximately 400 miles north of the international boundary and near the northern limit of settlement. They also lie within the vast boreal forest region of Canada, where the vegetative cover is rarely broken by exposures of underlying sedimentary strata and precipitation is often heaviest during the summer months. It is not surprising, therefore, that the fossil localities listed by Russell were all artificial exposures created in the course of road construction and drilling operations.

As Russell recognizes, most of the fossil occurrences are of little value except in that they facilitate the mapping of the surface expression of the contact between Cretaceous and Tertiary freshwater sediments. The author, showing a breadth of competency rare among contemporary palaeontologists, identified all of the megafossils recovered by his party, which incude the remains of conifers, mollusks, fish, reptiles and mammals. It may be noted in passing that the association of "ganoid" scales with skeletal elements of the amiid fish *Stylomyleodon* (=?*Kindleia*) presents no difficulty, as another amiid (*Sinamia zdanskyi* Stensio, 1935, Liu et al., 1963) from the late Jurassic or early Cretaceous of China also possesses squamation of the lepisosteid type (I am indebted to Michael Waldman for this information).

One of Russell's localities, however, produced 11 jaw fragments and 20 isolated teeth or tooth fragments of small mammals of late Paleocene age. Fifteen different forms are recognized, including one new species (*Carpolestes cygneus*)

of carpolestid primate. Despite its small size this collection is significant in that it represents the northernmost occurrence of Paleocene mammals in North America. It will not be an easy task to find significant new fossil vertebrate sites across the great expanse of the northern interior of our continent. We are indebted to Russell for making this occurrence known.

REFERENCES

LIU, T., H. LIU, and T. SU. 1963. The discovery of *Sinamia zdanskyi* from the Ordos Region and its stratigraphical significance. Vertebrata Palasiatica 7(1):1-30.

STENSIO, E. 1935. *Sinamia zdanskyi*, a new amiid from the lower Cretaceous of Shantung, China. Palaeontologia Sinica Series C, 3(1):1-48.

DALE A. RUSSELL

Curator of Fossil Vertebrates
National Museum of Natural Sciences
Ottawa, Ontario

The Olympic Rain Forest

By RUTH KIRK. Published in co-operation with the Olympic Natural History Association by University of Washington Press, Seattle and London. x + 86 pp. Photographs by Johsel Namkung and Ruth Kirk. 1966. $6.95 (U.S.).

This handsome photographic essay on the three river valleys, the Hoh, Queets and Quinault, which sustain the world-renowned rain forest of the Olympic Peninsula, should surely elicit a good deal of interest in 1969, the year of the XI International Botanical Congress in nearby Seattle, Washington.

Mrs. Kirk's running commentary on the natural history of these valleys sets the perspective in space and time for viewing the beautifully executed photographs more meaningfully. It is written, I think quite rightly, for the layman. Instruction in word and picture is most agreeably palatable from the wife of a park naturalist whose life has become very much a part of these valleys. The photographs, whether a panoramic view of the bounding hills bedecked with the enshrouding gossamer of a rising coastal fog or a detailed portrait, in full color, of a banana slug are well done and of considerable artistic merit. Mrs. Kirk and her photographic collaborator, Johsel Namkung, are to be complimented on an exquisite piece of work. Eight pages are devoted to color, the rest to black and white prints; all of them are good and many are sparkling treasures.

Man and his place in these valleys past, present and imponderable future are not omitted. Even the professional biologist is remembered in an appendix giving Latin binomials and brief descriptions of some of the more important floristic and faunistic elements in the ecosystem.

This title and its companion paperback volumes deserve a good market among those who would visit the Olympic Rain Forest.

WM. I. ILLMAN

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By the same publisher:

Exploring the Olympic Peninsula by Ruth Kirk. Illus., maps, $3.95, paperback $1.95 (U.S.).

Roads and Trails of Olympic National Park by Frederick Leissler. Illus., maps, paperback $1.95 (U.S.).

The History of Life

By A. LEE MCALESTER. Prentice-Hall, Englewood Cliffs, N. J. Foundations of Earth Science Series. viii + 152 pp., illus. Paperback. 1968.

For ill or good we live in the age of mass communication and telegraphic

conveyance of blocks of easily digested and imaginatively presented impressions. Hand-in-hand with electronic media and learning machines, we have been deluged with a plethora of paperbacks expounding this or that segment of natural history, usually, it must be admitted, in a way inferior to that in which more comprehensive treatises deal with the subject matter placed in a more general context.

This title, it seems to me, constitutes an interesting and most commendable exception. McAlester has given an introductory synthesis of stratigraphic geology and palaeontology with comparative morphology of plants and animals placed in the setting of modern evolutionary theory and physical anthropology. No small order? Indeed! But he has carried it off with comparatively few apparent blunders, inflicted, undoubtedly, by dictates of brevity which defies excursive accuracy.

The book is highly recommended for amateur naturalists, students and all others wishing to place to-day's natural scene in its historical perspective. And here is at least one professional biologist who felt he benefitted immensely from this painless synthesis of the vast panorama of life.

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Quick-Key Guide to Wildflowers of Northeastern and Central United States and Adjacent Canada

By DAVID ARCHIBALD, ROSEMARY V. FLEMING and VIRGINIA M. KLINE. Doubleday & Co. Inc. Garden City, N.Y. Illus. 198 pp. + 51 key cards. 1968. $5.95.

This is the fourth in a series of Quick-Key Field Identification Guides. Others in the series are: Guide to Trees, Guide to Birds, and Guide to Rocks and Minerals. These books employ a unique method of utilizing punch cards as an aid to identifying specimens.

The pocket-sized Guide to Wildflowers contains a selection of 545 of the more common and widespread flowers of Northeastern and Central United States and adjacent Canada. It is designed for the interested amateur, who may at the beginning have little or no knowledge of flowers, but a desire to learn. All the species are illustrated by fine line drawings many of which were used in Flora of West Virginia by P. D. Strausbaugh and E. L. Core. Pictures are three to a page. The accompanying text is minimal and includes the common name, Latin name, family common name, a simple description of the flower, height, range, habitat, and occasionally other brief notes.

Identification is accomplished by the superimposing of selected punched cards one upon the other until only 1 or 2 black dots show through. Cards are selected by following simple directions which are found on only 2 pages. Final identification is by comparison of the specimens with the line drawings.

The order of species is unconventional; species which appear similar, although actually unrelated, are placed close to one another for ready comparison. An index to both common and scientific names is provided.

As mentioned above this book is designed for the totally uninitiated individual who may wish to discover what is growing about him. From this useful book he can proceed to the more difficult dichotomous keys and more detailed descriptions of other floras and manuals as his interest develops.

W. J. CODY

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Central Experimental Farm
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The Ploughboy and the Nightingale

By DORIS PARKIN KEIL. Copp Clark, Toronto. x + 304 pp. 1958.

Lest any of my naturalist friends be under the misapprehension that this title is a scientific analysis of a Briton's favorite bird species, I must hasten to point out that it has little more to do with ornithology than the amazing discovery in 1851 of a fine collection of stuffed birds, replete with nests and eggs, curated by Dr. Sandys, rector of St. Paul's Episcopal Parish in Chatham, Ontario, by the great Swedish Nightingale, Jenny Lind.

I believe, however, that this romantic tale is obviously so well researched and so redolent of the local scene that at least a native of the Western District of Upper Canada will have no trouble in reliving with Mathew Van Dalsen the best remembered and most treasured week of his life.

Mrs. Keil's recounting of the varied scenes and sights of life along the Thames and the Lower Lakes in those pioneer days is guaranteed to bring satisfaction, titillation and tears to every sensitive naturalist.

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A Guide to Spiders and Their Kin

By HERBERT W. LEVI and LORNA R. LEVI. Illustrated by Nicholas Strekalovsky. A Golden Nature Guide, Golden Press, New York. 160 pp. 1968. Paperback, $1.35 in Canada.

One of the joys that the amateur in Britain and on the Continent has in observing nature is the great wealth of handbooks devoted to different groups of animals and plants. Such handbooks pertinent to the many parts of the North American fauna and flora have been sadly wanting and to a large measure have, I feel, held up and impeded the proper appreciation of nature by the enlightened dilettante.

The book that has recently come to me for review is a counterpart of the best of European handbooks. Dr. Herbert Levi and his wife are to be congratulated on their book on spiders, which has been so beautifully illustrated by Nicholas Strekalovsky. The arrangement of the spiders and their allies is well done, the descriptions, while brief, are good, the distribution maps are useful, and the line drawings are excellent.

In the past, many of the works devoted to spiders were very difficult for the amateur to use because of the complexity of the keys. This difficulty has been overcome in the Levis' book because a worker can compare his specimens with the excellent figures given.

It is to be hoped that the Golden Press will see its way clear to publishing more of the same kind of books for groups of organisms which have heretofore been neglected.

My only criticisms are minor. The colours, as one might expect in a book of this price, are adequate but fail to show the lovely metallic shades so common in spiders. Secondly, the section on mites is hopelessly inadequate. A second book on this topic would suffice.

H. H. J. NESBITT

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OTHER NEW TITLES

The following titles are presented as a service to readers. Their listing does not preclude them from possible review in a future issue of this journal.

Animal Communication. Techniques of Study and Results of Research. Thomas A. Sebeok (Ed.), Indiana University Press, Bloomington, 1968. Illus. 68 p. $20 (US).

Discovering Plants. A Nature and Science Book of Experiments. Richard M. Klein and Deana T. Klein. Natural History Press, Garden City, N.Y. 1968. Illus. 128 p. $4.50 (US).

Environmental Conservation. Raymond F. Dasmann. Wiley, New York, ed. 2, 1968. Illus. 384 p. $8.95 (US).

La Lutte contre les Pollutions. Milieux Inhales. Ingérés et Acoustiques. Jean A. Ternisien. Presses Universitaires de France, Paris, 1968. 184 p. Paperback, 14 F. La Science Vivante.

A Numerical Taxonomic Study of the Genus Salix, Section Sitchenses. Theodore J. Crovello. University of California Press, Berkeley, 1968. Illus. 64 p. Paperback, $2 (US) University of California Publications in Botany, Vol. 44.

Plant and Animal Geography. Marion Newbigin. Methuen, London, 1968 (distributed in the U.S. by Barnes and Noble, New York). 320 p. Cloth, $5.75; Paper, $3. University Paperbacks, No. 221. Reprint of the 1936 edition.

Les Pollutions et Leurs Effects. Milieux Inhales, Ingérés et Acoustiques. Jean A. Ternisien. Presses Universitaires de France, Paris, 1968. 189 p. Paperback 14 F. La Science Vivante.

Urbanization. Development Policies and Planning. U.N. Department of Economic and Social Affairs. United Nations, New York, 1968. Illus. 130 p. Paperback $2 (US).

Water Research in Canada. J. P. Bruce and D. E. L. Maasland. With a Special Report on the Contribution of Social Science Research to Water Resource Management in Canada, by W. R. Derrick Sewell. Science Secretariat, Ottawa, Canada, 1968 (available from the Queen's Printer, Ottawa). 170 pp. Paperback, $2.50, Special Study No. 5.

The World of the Grizzly Bear. Text and photographs by W. J. Schoonmaker. Lippincott, Philadelphia, 1968. 192 p. $5.95 (US). Living World Books.

Haldane and Modern Biology edited by K. R. Dronamraju, The Johns Hopkins Press, Baltimore, Md., 1968, 333 p., $10.95.

Entomology of Antarctica. Vol. 10, Antarctic Research Series, J. L. Gressitt (Ed.), American Geophysical Union, NRC-NAS Publ. No. 1574, Washington, D.C., 1967, Illus. 395 p. $17.00 (US).

The Ecology of Soil Bacteria. An International Symposium. T. R. G. Gray and D. Parkinson (Eds.), University of Toronto Press, 1968, Illus. 618 p. Ca. $23.00.

Perspectives in Ecological Theory. R. R. Margalef, University of Chicago Press, 1968, Illus., 111 p. $4.50 (US).

Studies in the Structure, Physiology and Ecology of Molluscs. V. Fretter (Ed.) Academic Press, Inc., London, 1968. Illus. 377 p. 90s or $15.00 (US).

The American University. How It Runs, Where It is Going. Jacques Barzun. Harper and Row, New York, 1968. 322 pp. $7.95 (US).

Bureaucracy, Politics, and Public Policy. Francis E. Rourke. Little, Brown, Boston, 1968. 180 pp. Paperback. $2.75 (US).

Ecology of Insect Vector Populations. R. C. Muirhead-Thomson. Academic Press, New York, 1968. Illus. 176 p. $9.50 (US).

Grasslands of the Monsoon. R. O. Whyte. Praeger, New York, 1968. Illus. + 40 plates. 328 p. $9.50 (US).

The Management and Conservation of Biological Resources. John D. Black. Davis, Philadelphia, 1968. Illus. 340 p. $7.50 (US).

The Measurement of Environmental Factors in Terrestrial Ecology. A symposium, Reading, England, 1967. R. M. Wadsworth, L. C. Chapas, A. J. Rutter, M.

E. Solomon, and J. Warren Wilson, (Eds.), Blackwell Scientific Publications, Oxford, 1968. Illus. 314 p. $9.50 (US). British Ecological Society Symposium, Vol. 8.

Oil and Water. The Torrey Canyon Disaster. Edward Cowan. Lippincott, Philadelphia, 1968. Illus. 242 p. $6.95 (US).

The Moth Book. A Popular Guide to a Knowledge of the Moths of North America — W. J. Holland, annotations and new foreword by A. E. Brower — Dover, 1968. 48 color plates, 263 drawings. 479 p. Paperback $5.00 (US).

Moving the Earth for A Song. M. Wilson Gaillard. John Knox Press, 1969. Photographs. 112 p. $4.(US). Considers the problem of saving habitat for migratory birds.

The Origin of Species by Means of Natural Selection or The Preservation of Favoured Races in the Struggle for Life. Charles Darwin, (Ed.), with introduction by J. W. Rurrow, Penguin Bks., 1968. 477 p. Paperback, $1.25 (US). Reprint of the 1859 edition.

America's Endangered Wildlife. George Laycock. Norton, 1969. Photographs. 266 p. $4.95 (US).

Plants: Adaptation Through Evolution. Joan Eiger Gottlieb. Reinhold, 1969. Photographs, drawings, 114 p. Paperback. $2.25 (US).

The Treatment of Industrial Wastes. Edmund B. Besselievre. McGraw-Hill, 1969. Photographs, diagrams, 403 p., $16.50 (US).

Seashells of North America: A Guide to Field Identification. R. Tucker Abbott. Golden Press, 1969. 280 p. 1,000 illus. in color by George F. Sandstrom, $5.95; paperback, $3.95 (US).

Climate and Agriculture. An Ecological Survey. Jen-Hu Chang. Aldine, Chicago, 1968. Illus. 304 p. $9.75 (US).

Elementary Probability for the Biological Sciences. James E. Mosimann. Appleton-Century-Crofts, New York, 1968. Illus. 256 p. Paperback. $3.95 (US).

Gas Chromatography. Orion Edwin Schupp III. Interscience (Wiley), New York, 1968. Illus. 422 p. $16.50 (US). Technique of Organic Chemistry. Vol. 13. Included in this list because of its relevancy to the problem of environmental contamination by pesticides.

Chemical Warfare: A Study in Restraints. Frederic J. Brown. Princeton Univ. Press, 1968. 355 p. $9. (US). Analysis of restraints — political, military, economic and psychological, operative in varying degrees between 1915 and 1945.

Pleistocene Extinctions. The Search for a Cause. Proceedings of the 17th Congress of the International Association for Quaternary Research, vol. 6. P. S. Martin and H. E. Wright, Jr., (Eds.), Yale University Press, New Haven, Conn., 1967. Illus. 453 p. $12.50 (US).

Atlas of the Pacific Northwest: Resources and Development. Richard M. Highsmith Jr., (Ed.), Jon M. Leverenz, Cartographer. Oregon State University Press, Corvallis, ed. 4, 1968. Illus. 168 p. $5. (US).

The Behavioral Sciences and the Federal Government. National Academy of Sciences, Washington, D.C., 1968. 110 p. Paperback, $3.25 (US). NAS Publication 1680.

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GOVERNMENTS MOVE TO BAN CHLORINATED HYDROCARBONS

The chlorinated hydrocarbon biocides include two groups of compounds, those dispersed as pesticides and those dispersed via industrial processes. The first group includes BHC, lindane, heptachlor, toxaphene, chlordane, aldrin, dieldrin and DDT. The products used by industry are called polychlorinated biphenyls and include a number of closely related compounds. Until recently, their length of life in natural environments was thought to measure from a few to at least several dozen years but some recent data from Sweden and California indicate that some of them may remain toxic almost indefinitely so that the total amount of these toxic materials may be steadily increasing in the biosphere as a whole. Even pesticide-free environments are not safe from contamination by these compounds because when used as a spray, a great deal (about one-half) does not hit the target and comes down as droplets, with precipitation or with dust particles up to many thousands of miles from where it was first released. The clouds seen by the astronauts contained many tons of DDT and other chlorinated hydrocarbons. And according to United Nations Secretary, U Thant, over a billion pounds of DDT alone have already been spread through the environment. Once released into the environment the chlorinated hydrocarbons cannot be controlled and eventually enter the ecological food chains where they are beginning to cause large-scale reproductive failures in fish, birds, crustaceans and other wildlife both on the continents and in the oceans where they are building up to increasingly higher levels. Right now, various species are already so contaminated that they are becoming extinct over large areas of their former ranges. Potential extinctions of the earth's biota on an enormous scale appear to be in the offing if we cannot stop or reverse present trends.

It is my personal opinion at this time that the problem of accumulating toxicity of the earth's natural environments is the prime pollution issue of our day. It is important for us to know that this toxicity is being caused by only a few, very specific, man-made biocides among which the chlorinated hydrocarbons are the most abundant and widely used. The issue is vital because this special kind of toxicity is now beginning to destroy the web of life and so to reduce the capacity of the earth to produce the many kinds of living resources upon which so many of us depend today and which will be needed even more by more numerous future generations. Once species become extinct they cannot be re-created; when complex environments lose their ancient stability we may not be able to re-establish them. By any cost-benefit logic the chlorinated hydrocarbons are threatening to destroy far more resources than they are protecting.

Many independent scients who do not have their jobs, empires or special relationships to protect, think that the chances of extinctions on a world-wide scale are very high indeed and also that they are probable — based only on present scientific knowledge and on extrapolations of present toxicity trends.

The following governments have recognized the problem and moved to ban at least some of these compounds within very recent time.

Sweden. This is the first country to announce a ban on DDT, including aldrin, dieldrin and lindane. The ban takes effect January 1, 1970 and will last two years.

Mailing date of this number: 13th November, 1969.

NORWAY. The manufacture and import of DDT will be illegal as of October 1, 1969, and all use will be banned as of October 1, 1970.

DENMARK. All use of DDT will be banned as of November 1, 1969. Stocks will be retained for several very specialized uses. The ban in Denmark is permanent.

HUNGARY. All use of DDT will be banned as of January, 1970.

UNITED STATES. Bills are pending in Washington that would severely restrict use of chlorinated hydrocarbons. The Agricultural Research Service and the Forest Service have suspended all use of these chemicals in departmental programs pending a review. (See Bioscience, 19:739 for details). Some 80,000 tons of DDT were manufactured in the United States in 1968. Most of this was for export.

CANADA. The Federal Government has the authority to withdraw or not grant the registration for the sale of any pesticide. The PEST CONTROL PRODUCTS ACT administered by the Department of Agriculture, governs sale of all pesticides. Uses of chlorinated hydrocarbons are currently under review and uses will be cut down in those areas where there are suitable substitutes but apparently no outright ban is planned as yet. According to the Dominion Bureau of Statistics, the amounts of DDT, aldrin and dieldrin used in Canada in agriculture alone are as follows:

Year	DDT	aldrin + dieldrin
1963	1.4 million pounds	580 thousand pounds
1964	1.2 " "	460 " "
1965	1.24 " "	520 " "
1967	1.7 " "	420 " "
1968	1.84 " "	442 " "
		278 " "

AUSTRALIA. In 1968 a ban was imposed on the application of DDT to livestock and fodder crops in order to protect export beef from being barred by importing countries that have set low tolerance limits to DDT-contaminated carcass fat.

ARIZONA. A one-year moratorium on DDT has been declared to reduce contamination of dairy products.

MICHIGAN. The first state to ban DDT. The Department of Agriculture moved to cancel all registrations for DDT in the state. This has made DDT illegal in Michigan.

WISCONSIN. A strong bill banning use of DDT has been passed by the State assembly. Speedy passage through the Senate is expected (Bioscience, 19:739).

ILLINOIS. A bill banning DDT has been passed by the house and is now before the Senate (N.Y. Times, April 30, 1969).

CALIFORNIA. This state will ban the use of DDT preparations for household uses as of January 1, 1970. Bills are pending in the State Legislature that would outlaw it completely in the state. At least one court case is pending and use on farms is being reduced.

PENNSYLVANIA. A State Commission has recommended banning DDT.

N. Y. CITY. Use in all N.Y. City Parks has been stopped after a pilot ban of 2 years in which biological control methods were found to be more effective.

HUNTINGTON TOWNSHIP, LONG ISLAND. DDT, aldrin and dieldrin have been banned.

ONTARIO. Ontario banned DDT in late September. The ban will take effect in January, 1970 and will reduce present use by 90 percent. DDT now joins aldrin, dieldrin and heptachlor as being banned from widespread use in the province.

— THEODORE MOSQUIN, September, 1969.

REGIONAL POPULATION DECLINES AND ORGANOCHLORINE INSECTICIDES IN CANADIAN PRAIRIE FALCONS

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Introduction

The International Peregrine Symposium held in Madison, Wisconsin, in August of 1965 focused attention on the recent declines in populations of the Peregrine Falcon (*Falco peregrinus*) and several other species of raptorial birds found in Europe and North America (Hickey, 1968). The declines were most pronounced in the bird- and fish-eating raptors, and there was evidence of a relationship between these population changes and the advent of the recent widespread use of organochlorine insecticides. More recently it has been shown that, on both continents, the populations which showed declines were characterized by egg-eating (*ibid.*) and by the production of eggs which showed reduced shell weight and thickness (Hickey and Anderson, 1968; Ratcliffe, 1967a). A similar reduction in shell thickness in the eggs of American Herring Gulls (*Larus argentatus*) from five states has been shown to have been inversely correlated with the amount of DDE in the egg contents (Hickey and Anderson, 1968). Analysis has also verified the presence of high levels of organochlorine insecticide residues in the tissues and eggs of the declining species (Cade, White, and Haugh, 1968; Enderson and Berger, 1968; Hickey and Anderson, 1968; Lockie and Ratcliffe, 1964; Moore, 1965; Ratcliffe, 1967b), higher than in related species that are not declining (Hickey and Anderson, 1968). Rudd (1964) demonstrated that low levels of organochlorine insecticide residues are concentrated by resistant organisms and are accumulated to a greater degree at each successive step along food chains in various ecosystems. In the last few years it has been demonstrated that a wide variety of these insecticides or their metabolites, including DDE, will induce increased production of hepatic microsomal enzymes in both mammals and birds. These enzymes in turn are capable of hydroxilating the steroid hormones which play a major role in regulating calcium metabolism and eggshell thickness during egg production (Peakall, 1967; Risebrough *et al.*, 1968).

Because of these findings and the documented presence of high residue levels in raptorial birds, the most plausible hypothesis is that those raptor species affected in the recent declines accumulated sufficient organochlorine insecticide residues to induce the production of unusually high levels of hepatic microsomal enzymes, and that the resulting breakdown of steroids was the primary cause of the widespread reduction in shell thickness and the parallel reproductive failure.

Following the peregrine symposium's documentation of raptor population declines, the Canadian Wildlife Service began to examine the status of potential-

ly threatened Canadian raptor populations, and to collect egg and tissue samples for pesticide residue analysis. This paper is the first of a series and summarizes the results of field investigations and organochlorine insecticide residue determinations in the Prairie Falcon (*Falco mexicanus*) in western Canada during 1966, 1967, and 1968.

METHODS

In 1966, 1967, and 1968 field investigations were carried out to assess the populations of Prairie Falcons in southern Saskatchewan and Alberta. In Saskatchewan, field work was restricted to two areas (A and B, Fig. 1) chosen because we had earlier population data for comparison. Since little comparative information was available in Alberta, investigations there consisted of initial surveys in areas of suitable habitat (C,D,E,F, Fig. 1). Comparisons were then made wherever possible.

During the investigations, all nest locations were mapped and data recorded on occupancy, nest success, and behavior of the adult birds. Whenever possible the nests were revisited and young falcons banded. In 1967 and 1968, samples were collected for residue analysis. These included both fresh and unhatched eggs, prey species, and in one instance four young Prairie Falcons found dead in a nest. Each sample was wrapped in aluminum foil, frozen, and sent to L. M. Reynolds of the Ontario Research Foundation for analysis in the following manner.

The sample is homogenized where possible, and an aliquot (*ca.* 3 g) is analysed as follows: Moisture is determined by the use of a vacuum oven at low temperature. The dried material is ground with anhydrous Na_2SO_4, and the fat is estimated by Soxhlet extraction with 1:2 ether:hexane mixture as the extractant. The solvent is removed from the extract and the fat residue is weighed. The pesticides are then separated from the fat by cold precipitation and filtration of the fat with the aid of a charcoal-Celite pad. The extract containing the pesticides is cleaned-up further on Florisil (some samples need no further cleanup) and analysed by gas liquid chromatographic-electron capture detection technique. Confirmation of the pesticides is by thin-layer chromatography but is supplemented by chemical reactions for specific pesticides. When polychlorobiphenyls appear to be present, a special Florisil separation by hexane elution is carried out. The method is sensitive to about 0.001 ppm.

Before sending the egg contents to L. M. Reynolds, the outer dimensions of the intact eggs were measured, after which the contents were removed and the shells washed and allowed to dry at room temperatures. Once dry, the shells were weighed to 0.01 g, their length and breadth recorded, and four measurements of the thickness of the eggshell less membranes were taken around the girth of the egg. The mean of these measurements was used to represent the shell thickness of the individual egg.

Possibly because of relatively limited nesting habitat, Prairie Falcons in western Canada traditionally nest in the same general location each year. The number of pairs nesting in any area of suitable habitat appears to remain very constant, making it possible to census populations of this species with a reason-

FIGURE 1. Outline map of Saskatchewan and Alberta showing areas investigated.

able degree of accuracy. The nest location is generally referred to as the eyrie or site (Enderson, 1964; Hickey, 1942; Webster, 1944), however, since the exact location of the eyrie or nest site may vary from year to year on a given cliff, or series of cliffs, we are using the term nesting territory to describe traditionally used nesting locations.

Figures on populations and population changes are based on the number of occupied nesting territories in each area (Table 1). For our purposes an occupied territory is defined as any previously known territory occupied by a pair of adult Prairie Falcons or any cliff defended by one or two adult Prairie Falcons at any time during the breeding season.

OBSERVATIONS

A. POPULATIONS

Investigation in 1966 of prairie falcon nesting territories identified by Fyfe in 1958 and 1959 indicated that a sharp decline in the number of occupied territories had occurred in area B, with eight of nine former territories deserted. In sharp contrast, in area A six of seven 1958 and 1959 territories were occupied and one new territory was located. Area C was investigated for the first time in 1966, and 13 active territories were located.

Field work carried out in areas A and C during the spring of 1967 indicated no change from the year before in the number of occupied territories. However, although the number of territories remained the same, one nest in area A was deserted during incubation for no apparent reason. This nest originally

TABLE 1.—Prairie Falcon nesting territories investigated.

Area	1966				1967				1968			
	Previously known territories			New territories	Previously known territories			New territories	Previously known territories			New territories
	Checked	Occupied	Unoccupied	Occupied	Checked	Occupied	Unoccupied	Occupied	Checked	Occupied	Unoccupied	Occupied
A	7	6	1	1	8	7	1	0	8	7	1	3
B	9	1	8	0	–	–	–	–	9	1	8	1
C	–	–	–	–	13	13	0	1	14	14	0	0
D	–	–	–	–	–	–	–	–	4	0	4	11
E	–	–	–	–	–	–	–	–	7	7	0	9
F	–	–	–	–	–	–	–	–	10	5	5	6
Total	16	7	9	1	21	20	1	1	52	34	18	30

contained three eggs, one of which was collected fresh for analysis. The remaining two eggs were fully incubated yet failed to hatch although they contained two fully developed chicks. The subsequent residue analysis and shell measurements are discussed later.

In 1968 field investigations were continued in areas A, B, and C with results for known territories almost identical with those recorded in 1966 and 1967. The only difference in the 1968 results was the discovery of four new territories, one in area B and three in area A. The number of occupied territories in relation to previously known territories remained the same in all areas.

During 1968 the survey was extended in Alberta to include three areas (D, E, and F) new to us, and in these three areas a total of 21 territories known from the preceding five years were investigated, and 26 new territories were found. Of the 21 previously known territories, all 7 in area E were occupied whereas only 5 of the 10 in area F and none of the 4 in area D were occupied. The number of known occupied Peregrine Falcon territories in area D had also declined from six in 1960 (Decker, 1967) to none in 1968, and the two in area F also became unoccupied during the same interval. Although no Peregrine Falcons were observed by us in these areas, five single prairie falcons in area F, two in area D, and one in area C were observed at cliffs. In all instances these birds flew silently from what appeared to be good nest sites but which proved empty and were not defended although the birds remained in the area. This pattern of single birds at nest sites was a characteristic of the declining populations of Peregrine Falcons.

Enderson (1964) noted that of the 36 Prairie Falcon territories in his study an average of 11 percent remained unoccupied each of the three years. Although he does not suggest a decline in the Prairie Falcon populations, he does

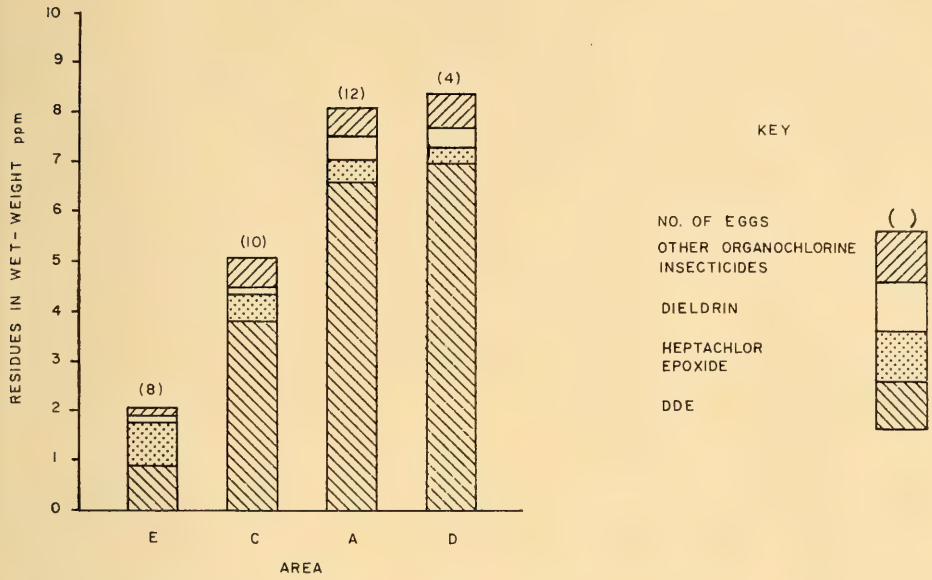

FIGURE 2. Insecticide residues in Prairie Falcon eggs averaged by area.

indicate that three of the eyries which were unoccupied had not been occupied for four or five years.

Observations show no change during 1966, 1967, and 1968 in the number of known territories occupied in areas C and E. In the remaining four areas the number of occupied territories has declined from 31 to 13 during the last 10 years, a loss of 34 percent of the 52 known territories investigated.

Our observations indicate that the Prairie Falcon declines in western Canada are limited to specific areas. The two most marked declines are less than 100 miles from areas where no declines have been observed. This variation suggests that the factors which are adversely affecting this species, though widespread, are not uniform. Also the lack of change in areas A, B, and C during the past three years suggests that those pairs which have not been affected are able to survive because their location, food preferences, or specific behavior patterns have in some way isolated these birds from the decimating factors.

We were not able to revisit every nest at or immediately following fledging, therefore, it is not possible to indicate definite fledging success. The 1968 production of nestlings based on the number of young found in the nests is given in Table 2. Since second visits were made to most nests we have expressed production as nestlings produced per occupied territory and nestlings produced per successful pair. In 1968 nestlings per successful pair averaged 3.57 (range 2.4 to 4.2) giving an indication of the productivity of those pairs reproducing successfully. Nestlings per occupied territory in 1968 averaged 2.5 (range 1.5 to 3.25), which gives a more reliable indication of the reproductive success of the species in each area since it takes into account nest destruction and desertion. Our mean of 2.5 nestlings per occupied territory is con-

Table 2.—Prairie Falcon production and organochlorine insecticide levels by area.[1]

Area	Occupied territories	Successful pairs	No. of nestlings	N/S[2]	N/O[3]	Total egg-residues in ppm wet weight		
						Mean	Range	N
D	11	7	17	2.4	1.5	8.45	(1.67–13.60)	4
A	10	6	23	3.8	2.3	8.13	(3.38–21.66)	12
F	11	7	27	3.8	2.5	–		
C	14	9	38	4.2	2.7	5.16	(2.07–10.77)	10
E	16	15	52	3.5	3.2	2.09	(1.07–4.04)	8

[1]Production is of 1968, insecticide levels are of 1967 and 1968.
[2]Nestlings produced per successful pair.
[3]Nestlings produced per occupied territory.

siderably higher than Enderson's average of 1.9 recorded during his 1960-62 study in Wyoming and Colorado (Enderson, 1964). This would suggest that the prairie falcons in western Canada are reproducing successfully. However, since many of the eyries were located for the first time in 1968 it is entirely possible that our figures are high because nests which were deserted early in incubation may have been missed whereas successful eyries were readily located. The data suggest that the lowest nestling production occurred in areas A, F, and D, which are three of the four areas of recent population decline. The fourth area, B, was not revisited, so we have no nestling data for it. We can then conclude that the regionally limited Prairie Falcon declines are continuing.

B. Insecticide Residues

Of 36 Prairie Falcon eggs from four areas analysed by L. M. Reynolds, all contained measurable residues of organochlorine insecticides. These eggs averaged 6.9 percent fat and 79 percent moisture (69 – 85 percent), and residues are expressed on a wet-weight basis except in Fig. 3, which is based on dry weights. All eggs contained residues of DDE, heptachlor epoxide, DDD and pp′-DDT; all but two contained residues of dieldrin and six contained residues of pp′-DDT. In the three areas, where residue levels were highest, DDE was by far the largest component in the eggs (Fig. 2).

Total residues in our samples show a wide range of contamination, from 1.07 to 21.66 ppm wet weight, yet the levels in the eggs from each area tend to be similar. Although the sample is too small to draw definite conclusions from, nestling production is lowest in those areas with the highest residue levels (Table 2). Heptachlor epoxide and dieldrin, although usually present in small amounts in our samples, are by most criteria many times as toxic to birds as DDT or its metabolites.

Recent experimental evidence of Enderson and Berger (1969) shows that Prairie Falcons can accumulate high levels of dieldrin after eating only a few highly contaminated items. They also demonstrated that a corresponding increase was found in the contamination levels of the eggs if the items were

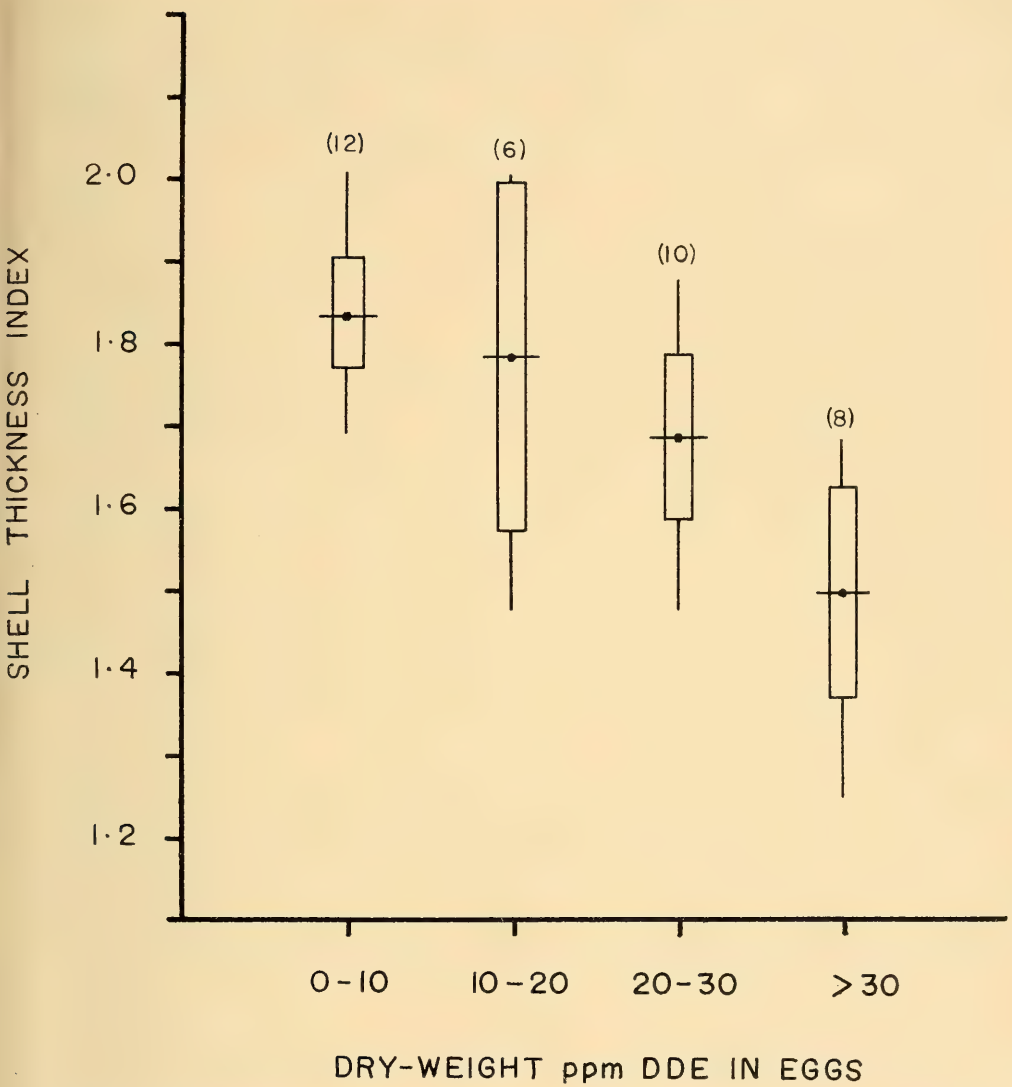

FIGURE 3. Variation of shell-thickness index with DDE concentration in Prairie Falcon eggs. Sample numbers are in brackets, horizontal lines are means, boxes are 95 percent confidence limits, and vertical lines are sample ranges.

fed to the falcons immediately before egg laying. Prairie Falcons in western Canada return to the nesting territories several weeks before egg laying and so much of the insecticide residues in the eggs may be accumulated from the prey in the vicinity of the nest during this period.

Individual variation in residues in the eggs within any one area probably results from specific prey abundance or food preferences of individual birds. Considerable individual differences in food preferences are already established

for the Prairie Falcon (Enderson, 1964; Webster, 1944; Edwards, 1968; Bent, 1938), and since different prey species carry different residue levels these differences would be reflected in the eggs. On this basis it is also possible that the similarities in egg-residue levels found within each area also reflect specific prey abundance or preferences in a given region.

C. Eggshell Thickness

DDE was the predominant residue in all eggs with relatively high total residues (Fig. 2). This metabolite of DDT has in the past not been considered of great importance because of its reportedly low toxicity; however, recent research into the effect of organochlorine insecticides in relation to calcium metabolism during egg production has resulted in a reassessment of the significance of sublethal levels of this (Hickey and Anderson, 1968) and other chemicals (Peakall, 1967; Jones and Summers, 1968; Enderson and Berger, 1969; Jefferies, 1967; Risebrough *et al.*, 1968). It is now recognized that the potential results of sublethal levels of these substances are a far more serious and long-term threat in the environment than the immediate threat posed by their toxicity on application (Risebrough *et al.*, 1968).

A comparison of dry weight DDE levels in the egg content with Ratcliffe's (1967a) shell-thickness index (weight/length $\times$ width) is shown in Fig. 3. We use the index here, rather than our thickness measurements, to allow direct comparison with the American data of Enderson and Berger (1969), and because relationship with DDE was essentially the same using either index or actual thickness values.

To compensate for any minor variability in analyses and to facilitate comparison with Enderson and Berger (*ibid.*), the eggs were grouped into classes of 10 ppm dry weight. The mean thickness index of the eggs with 0 - 10 ppm DDE is 1.834. The mean index then shows a decrease in each class to a low of 1.497 for those eggs with more than 30 ppm DDE, a decrease of 18 percent. These data suggest a decrease in shell thickness as the DDE residue levels increase and are similar to Enderson and Berger's (1969) findings for this falcon in Colorado.

Considering our 36 eggs as a current sample of Canadian Prairie Falcons, the mean thickness index is 1.71, with 95 percent confidence limits of 1.65 to 1.77. This is a significant drop of 11 percent from a pre-organochlorine-insecticide era figure of 1.93, with 95 percent confidence limits of 1.91 to 1.95, taken from 192 eggs from Alberta, Saskatchewan, Montana, Nebraska, Wyoming, and South Dakota (unpublished data of Anderson and Hickey).

D. Nestling Mortality and Egg Hatchability

Analysis of the brains of two of four young falcons found dead in a nest in 1968 in area C showed the two combined tissues to contain 5.05 ppm (wet weight) heptachlor epoxide, 0.322 ppm dieldrin, 3.06 ppm DDE, 0.035 ppm DDD, 0.044 ppm pp′-DDT. Although there are species differences in the

average lethal brain residue levels it has been shown that brain residues of dieldrin of 4 or 5 ppm (wet weight), or higher, indicate that an animal was in the known danger zone and may have died of dieldrin poisoning (Stickel, Stickel, and Spann, 1968).

Since dieldrin and heptachlor epoxide are considered to have similar toxicity, the 5.05 ppm (wet weight) heptachlor epoxide level falls within this danger zone and suggests that these birds may have died of insecticide poisoning. The presence of these levels in four- to five-week-old nestlings indicates that significantly high residue levels are being accumulated from the prey species found in western Canada not only during the egg-laying season, but also some two months later.

Enderson and Berger (1969) have demonstrated that in Prairie Falcons thin-shelled eggs resulted in lower hatchability with only 10 percent of those pairs having eggs with a thickness index below 1.45 fledging one or more young. During our investigations one nest in area A containing two well-developed eggs which had failed to hatch was deserted. Subsequent measurements and analyses showed an average shell thickness index of 1.40 with a corresponding mean total residue content of 16.2 ppm wet weight, of which 15.3 ppm was DDE. On a dry-weight basis, these ppm values are 73.6 for the total and 69.8 for DDE. The mean thickness index of 1.40 suggests that these eggs failed to hatch because of abnormally thin egg shells apparently induced by high levels of DDE.

SUMMARY

Investigations into the status of Prairie Falcons in western Canada were carried out in 1966, 1967 and 1968. Samples were collected and residue analyses conducted on Prairie Falcon egg contents and tissue samples.

The field investigations show a 34 percent reduction in the occupancy of territories known in the previous 10 years. This reduction has been concentrated in four of six areas studied, and current nestling production is also lowest in three of these same four areas (we lack nestling data for the fourth area).

All egg and tissue samples analysed contained organochlorine insecticide residues, principally DDE, with generally smaller amounts of heptachlor epoxide and dieldrin. Total residues in eggs ranged from 1 – 22 ppm wet weight, but levels in the samples within each area were similar. A comparison of eggshell thickness to DDE levels in the eggs shows a decrease in shell weight and thickness with increasing DDE levels. These shells are significantly thinner than shells of eggs laid before the widespread use of organochlorine insecticides.

High heptachlor epoxide levels may have caused the death of four young falcons, and high DDE levels may have caused the hatching failure of two fully-developed and thin-shelled falcon eggs.

Areas with the lowest rate of production of nestling falcons were also the areas with the highest DDE levels in falcon eggs.

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ECOLOGICAL NOTES ON THE MAMMALS OF SOUTHERN QUEBEC

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Introduction

This study is concerned with the distribution, habitat and life history of the mammalian fauna of extreme southern Quebec. Data were collected during four years (1965-1968) of intermittent trapping and observation, mainly in the region south of the St. Lawrence River bounded by the Canadian-United States boundary, and a line through the Monteregian Hills to Compton County, Quebec. This area has received little attention from naturalists. Peterson (1966) recorded the few mammal specimens from here, and the Redpath Museum, McGill University, has a small collection from Mont St. Hilaire. During the present study 611 specimens of 31 species were preserved, including a small series from Bark Lake (Argenteuil Co.) and Camp de la Roche, Laurentides Park (47° 41′ N; 70° 50′ W). Many species are recorded for the first time in the area, and are among the first collected in the province. Ten other species were observed, and six are known to occur here but were not detected (Hairy-tailed mole, Eastern long-eared bat, Least bat, Eastern pipistrelle, Red bat, Hoary bat). Six species appear to have been extirpated (Timberwolf, Marten, Wolverine, Cougar, Wapiti, Woodland caribou), and six species are regarded as hypothetical inhabitants (Gray long-tailed shrew, New England cottontail, Yellow-nosed vole, Coyote, Gray fox, Eastern flying squirrel).

The distribution of subspecies of the smoky shrew, eastern chipmunk and red-backed vole is discussed. Measurements are in millimeters. The specimens are deposited in the following institutions: National Museum of Canada, Ottawa; Redpath Museum, McGill University, Montreal; Department of Tourism, Fish and Game, Quebec; Museum of Natural History, University of Illinois, Urbana.

Flora and Physiography

The main study area lies within the Great Lakes – St. Lawrence Forest Region (Rowe, 1959), where southern deciduous and northern coniferous plant communities merge to form a diverse flora. Two geographic sections have been recognized which have an important bearing on mammalian distribution. The Upper St. Lawrence Section includes the lowlands in the north and west and the Monteregian Hills, a chain of eight large hills which rise abruptly from the plain. The forests are largely beech-sugar maple, with admixtures of hemlock, red maple, yellow birch, white elm, basswood, oaks, ashes, white pine and cedar. Most of the original forest has been cleared during several hundred years of agriculture.

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The Eastern Townships Section lies to the southeast, on the northwestern fringe of the Appalachian Mountains. Though the valleys are extensively farmed, the hills and mountains remain well covered with deciduous-coniferous forest. Sugar maple, yellow birch, white birch, largetooth aspen, white spruce, red spruce, white pine, balsam fir and hemlock are most important, particularly with increasing elevation. Many mountains are over 2000 feet in elevation and the highest are the Sutton Mountains at 3100 feet.

The region investigated in Laurentides Park is well within the boreal forest, and contains black spruce, white spruce, balsam fir and tamarack. The Bark Lake area is similar to the Eastern Townships Section.

CLIMATE

Mean daily seasonal temperatures in the study region are: January 10-15°F, April 35-45°F, July 65-70°F, October 45-50°F. Annual minimum-maximum temperatures range from -30°F to 95°F. Mean annual precipitation is 36-42 inches, while the annual snowfall ranges from 80-110 inches. Due largely to higher elevation, the Eastern Townships Section receives an annual average of 15 more inches of snow, and 20 fewer frost-free days (100-120) than the Upper St. Lawrence Section (Atlas of Canada, 1957).

GEOGRAPHICAL AFFINITIES OF THE MAMMALIAN FAUNA

An ecotone of two major animal communities occurs in extreme southern Quebec – the boreal and deciduous forest biociations. Vegetation, climate, soil and interspecific competition appear to be important factors affecting the distribution of mammals in this region, however, specific information is mostly lacking. Twenty-two species reach their northern limits, and four species attain their southern limits of distribution in or near this region.

Northern Limit
Opossum
Gray long-tailed shrew
Hairy-tailed mole
Eastern long-eared bat
Least bat
Indiana bat
Eastern pipistrelle
Big brown bat
Red bat
Hoary bat
Eastern cottontail
New England cottontail
Gray squirrel
Eastern flying squirrel
White-footed mouse
Pine vole
Gray fox
Raccoon
Long-tailed weasel
Bobcat
Cougar
Wapiti

Southern Limit
Eastern phenacomys
Northern bog lemming
Wolverine
Woodland caribou

The St. Lawrence River does not appear to have been an important barrier to mammalian dispersal northwards, subsequent to the last glacial recession. Species inhabiting regions north of the river either crossed the stretch of water or winter ice, or immigrated from Ontario. Interruption of gene exchange in populations on opposite shores has resulted in the formation of geographic races in the eastern part of the ranges of many species, especially across the Gulf of St. Lawrence. However, farther upstream (southwest) from the study area, such differentiation is present only in the woodland jumping mouse and pygmy shrew.

South of the St. Lawrence River, there exists a progressive change in climate and vegetation from the deciduous forests in the vicinity of Lake Ontario to the boreal forest of the Gaspe Peninsula. Seventeen species of mammals have evolved different subspecies in the two areas. Within the study region, four subspecies intergrade, four have affinities with northeastern populations, and nine more closely resemble populations to the southwest (Hall and Kelson, 1959).

SW Affinities
Water shrew
Short-tailed shrew
Snowshoe hare
Northern flying squirrel
Deer mouse
Red-backed vole
Woodland jumping mouse
Short-tailed weasel
Long-tailed weasel
Intergrades
Pygmy shrew
Red squirrel
Meadow jumping mouse
Red fox

NE Affinities
Smoky shrew
Woodchuck
Beaver
Bobcat

Several hundred years of land cultivation and settlement have altered the original mammalian fauna of this region. The disappearance and reduction of species have resulted mainly from habitat destruction, hunting and trapping. Unfortunately, as these forces continue, many more species will be exterminated. Meadow voles and woodchucks have likely prospered with the increase of grassy clearings.

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SPECIES' ACCOUNTS

Sorex cinereus (Kerr). MASKED SHREW

This common species occurred in a wide variety of habitats, and over 60 individuals were captured. Mature deciduous-coniferous woods with a thick leaf mold, rank growths of grasses and sedges, and occasionally sphagnum bogs, supported high populations. Dry or exposed situations were avoided.

Trapping during the spring at South Bolton revealed a predominance of males (22 males, 6 females) which may have been due to greater activity in search of females.

The testes of all males were enlarged (over 5.3 mm) prior to April 18. Two females on April 26, one on May 1, and two on May 6 were in estrus, while another on the latter date had eight embryos. A female taken on September 26 had recently produced a litter. One male was parasitized by a coiled nematode larva in the fascia of a hind leg.

Specimens collected: South Bolton, 16; Glen Sutton, 1; Dundee, 2; Stanbridge East, 1; Camp de la Roche (Laurentides Park), 18. Total 38.

Sorex fumeus (Miller). SMOKY SHREW

Twenty-five smoky shrews were captured in the mountains; none in the lowlands. The preferred habitat appeared to be damp deciduous-coniferous forest. Most were trapped around stumps, under mossy logs, and in the cover of yew boughs and ferns near streams. Two shrews were found on a talus slope in a stand of red pine, hemlock, yellow birch, and another was taken in sugar maple woods at the edge of a field.

The breeding season likely occurs from mid-April to late August in this region. Five males collected from April 14 to May 1 had enlarged testes (over 5 mm), and pregnant females were taken on April 22, May 2, 6. An aged female revealed recent placental scars on July 22. Seven shrews, all from spring litters, obtained from October 9 to 29 (3 males, 4 females) showed no breeding sign. There was evidence, then, for at least two reproductive periods, with a litter size averaging 6.6 (6-8). One female from South Bolton had a coiled nematode larva in the fascia between the scapulae.

These specimens were referred to *S. f. umbrosus* (Jackson) on the basis of dark grayish brown pelage and large size. The average and extreme measurements of eight adults were as follows: total length, 121.5 (117-131); tail, 48.4 (47-50); hind foot, 14.0; weight, 7.0g (6-10).

Specimens collected: Mont St. Hilaire, 1; South Bolton, 15. Total 16.

Sorex palustris (Richardson). WATER SHREW

This species was rare and found only at one locality in the mountains, where five specimens were taken at one place along a stream in deciduous-coniferous forest. A single pitfall trap, placed amid sedges and ferns on the gravel shore, captured four of the shrews (two in one night). The flank glands were enlarged and emitted a strong, musky odor. The scent was noticeable in the vicinity of the trap site, and probably attracted other shrews to that particular trap.

Four males trapped on April 22, 26, and May 1 had large testes (5-7 mm). A female collected on June 14 revealed no reproductive sign.

Specimens collected: South Bolton, 5.

Microsorex hoyi (Baird). PYGMY SHREW

This rare species was not found in extreme southern Quebec, but it no doubt occurs here. Two specimens were captured in pitfall traps at Laurentides Park — one in a damp, white spruce stand several yards from an alder-lined stream, the other in a sphagnum bog.

Specimens collected: Camp de la Roche (Laurentides Park), 2.

Blarina brevicauda (Say). SHORT-TAILED SHREW

Blarina was found in a wider range of habitats than any other small mammal, and was often the most abundant. Friable soil, moisture, and cover, in the form of decaying vegetation, dense herbs, or fallen logs, were essential components of the microhabitat. Damp, mature deciduous-coniferous woods consistently supported the highest numbers. Fields of tall grasses and sedges were also inhabited. The only situations avoided were dry fields and woods, and talus slopes.

The breeding season extended from late April to early September. Males with enlarged testes (over 9 mm) were found from April 26 to September 2. One female was in estrus on May 6, three contained embryos in May, June and July, and nine others revealed recent reproductive signs (placental scars, lactation) up to September 27. The average number of young in six litters was 6.8 (5-8).

Twelve percent of the short-tailed shrews examined were parasitized by a coiled nematode larva. One to five worms were situated in the scapular fascia. One shrew had red mites on the anus.

The specimens from extreme southern Quebec were referred to *B. b. talpoides* (Gapper) rather than *B. b. hooperi* (Bole and Moulthrop), due to large size. Seventy-one adults averaged: total length, 128.8 (118-144); tail, 26.8 (22-31); hind foot, 15.7 (15-17); weight, 20.0g (15-28).

Specimens collected: Bark Lake (Argenteuil Co.), 1; Dundee, 13; St. Sebastien, 1; Mont St. Hilaire, 6; Mont Yamaska, 2; Mont Shefford, 4; Mont Orford, 5; Mont Echo, 7; Glen Mountain, 13; South Bolton, 37; Glen Sutton, 3. Total 92.

Condylura cristata (Linnaeus). STAR-NOSED MOLE

This mole was locally common over most of the area. Characteristic earth mounds and runways in bogs, moist fields and woods, were particularly evident in the spring. A male collected on April 27 had enlarged testes (19 × 11 mm), and a female on the same date revealed four 12 mm embryos, plus one reabsorbed embryo.
Specimens collected: South Bolton, 3.

Myotis lucifugus (LeConte). LITTLE BROWN BAT

This species was the most abundant bat occurring around forests, orchards, marshes, lakes, streams and buildings. At Dundee, a mummified individual was found entangled in a burdock. The largest population was observed at Bark Lake, a heavily forested area of mature, deciduous-coniferous trees and plentiful lakes. Several cottages were utilized as roosting sites by hundreds of bats.

One female contained a 12 mm embryo on June 8. A male had enlarged testes (6 × 3 mm) on August 23, suggesting the breeding season was approaching. The warm, crowded summer roosts (all females) encouraged the spread of ectoparasites, and all specimens examined were heavily infested.
Specimens collected: Bark Lake (Argenteuil Co.), 4; Mont St. Hilaire, 3. Total 7.

Lasionycteris noctivagans (LeConte). SILVER-HAIRED BAT

This migratory species was seen often at Mont St. Hilaire, suggesting its general occurrence in the area. It appeared in apple orchards and a quarry beside beech woods. The silver-haired bat emerged at late dusk and was usually solitary. The high, erratic flight and late appearance made it especially difficult to collect. One female, obtained by Mr. Raymond Clarke, on August 24, revealed one old placental scar.
Specimens collected: Mont St. Hilaire, 1.

Eptesicus fuscus (Beauvois). BIG BROWN BAT

This large bat was found at only two localities though it may have been common in the St. Lawrence Valley. It was often observed flying over orchards, deciduous forest edges, and in the vicinity of buildings at Mont St. Hilaire. It emerged early in the evening, and two were seen flying an hour before sunset. Members of this species consistently foraged in groups of two or three.

A female collected on July 6 revealed two recent placental scars, and another on September 1 had two old scars. A male taken on August 29 had enlarged testes.
Specimens collected: Mont St. Hilaire, 5.

Lepus americanus (Erxleben). SNOWSHOE HARE

The hare was common in many areas and almost any type of forest appeared to provide sufficient food and cover. However, it was most abundant in northern hardwoods mixed with hemlock, balsam fir or white pine, particularly along the edges of meadows. The presence of hares was conspicuous in winter, with tracks and woody droppings in the snow, and shrubs stripped of bark several feet above snow line. Forms were located either under conifer boughs or excavated several feet into the snow.
Specimens collected: Mont Echo, 1; South Bolton, 1. Total 2.

Sylvilagus floridanus (Allen). EASTERN COTTONTAIL

The cottontail occurred only locally, and appeared to be absent from many suitable areas. Population numbers were reported to fluctuate, and cottontails were scarce at this time. The only individuals personally observed were in lanes in St. Lambert.

Sciurus carolinensis (Gmelin). EASTERN GRAY SQUIRREL

The St. Lawrence lowlands and all Monteregian Hills supported gray squirrels, while only a few scattered colonies were discovered in the mountainous areas of Brome County. This species was closely associated with tracts of hardwood forest containing beech, oak or hickory. Mature trees were necessary to provide sufficient mast for the long winter period as well as nesting holes to avoid severe climatic conditions. In winter and spring, individuals were observed digging through deep snow in search of food in the leaf litter. Since food and cover requirements are not fulfilled in the coniferous forest to the north, the gray squirrel reaches its northern limit of distribution in extreme southern Quebec.

Few data were obtained on reproduction as both pregnant females and young remained in or close by the nest. On May 13, a female was observed in the act of moving the family to a new nest hole 150 yards distant. The juveniles were covered with fine, gray fur, and were being carried by the abdomen in the female's mouth. Two other females revealed placental scars on August 15 and September 11, while a male had enlarged testes (15 mm) on August 4. There is thus, evidence for two annual litters, in early May and early August.

Specimens collected: Mont St. Hilaire, 3; St. Sebastien, 2; St. Lambert, 1. Total 6.

Tamiasciurus hudsonicus (Erxleben) RED SQUIRREL

Red squirrels were common both in the mountains and lowlands, particularly in conifer stands (spruce, pine, hemlock, balsam fir, white cedar. Small deciduous woodlots and fencerows harbored several, as long as there were a few conifers present. Fall food caches in hollow trees contained apples, fungi, maple samaras, conifer cones, and mast of beech, oak, hickory and butternut. During the late winter, buds of balsam fir and numerous deciduous trees were heavily utilized.

There appeared to be two breeding periods for this species. Lactating females with recent placental scars were found on June 9, July 20, August 23, two on September 11, while another was in estrus on June 12. Males with enlarged and descended testes were taken from early April to early September. Weaned young were observed foraging on the ground in early June. Most young were probably born in May and August. Placental scar counts of three females averaged 5 (4-6).

Specimens collected: South Bolton, 7; St. Sebastien, 4; Dundee, 4. Mont St. Hilaire, 3; Ayers Cliff, 1; Mont Bruno, 1; Mont Yamaska, 1; Bark Lake (Argenteuil Co.), 1; Camp de la Roche (Laurentides Park), 2. Total 24.

Marmota monax (Linnaeus). WOODCHUCK

The woodchuck is one of the few mammals to have benefited from the clearing of forests. The greatest number occurred in open areas where a rich herbaceous growth provided abundant food. Damp, shady coniferous stands were avoided, but burrows could usually be detected in open deciduous forest, both on mountainsides and flatlands. The forest edge was particularly attractive since it afforded good cover and close proximity to food. The woodchuck was often seen climbing on rocky fencerows and half-fallen trees, and one individual was even observed high in a hemlock, but it experienced considerable difficulty in descending.

Though this hibernator was observed abroad from April 23 to September 26, some individuals were no doubt active in March and October.

A female and her five young were seen on June 2. One of the latter weighed 500 grams and was estimated to be 6-7 weeks old, so that parturition probably occurred in mid-April. An older juvenile (838g) was retrieved from a red fox on June 6.

Specimens collected: Mont St. Hilaire, 2; East Hill, 3 mi. W South Bolton, 1. Total 3.

Tamias striatus (Linnaeus). EASTERN CHIPMUNK

The chipmunk was one of the most common and conspicuous mammals in wooded areas, from shrub stage to climax forest. Mature beech-maple woods supported the greatest numbers, and in deciduous-coniferous woods there was a marked tendency to occupy open, brushy glades and the forest-edge rather than the dark interior. Examination of stomach contents and cheek pouches revealed numerous kinds of nuts, seeds, insects and snails.

The first chipmunks out of hibernation were observed at Mont St. Hilaire on April 15, 1966, and April 16, 1967, when there was still a considerable snow cover in the forest. However, since the latter specimen contained small embryos, it must have been active several weeks prior. Much body fat was also present. Over a dozen chipmunks were seen at South Bolton on October 22, just previous to several days of freezing temperatures. Thereafter, none was found and presumably the majority had commenced hibernation.

There were two breeding seasons in this region, with young born in late April—early May, and August. One female contained small embryos (3 mm) on April 16, another was lactating on May 6, and a third revealed recent placental scars on May 16. Juveniles were out foraging in late May. Recent placental scars were found in four August and three early September specimens, and juveniles were collected in mid-

September. The average number of young in 11 litters was 4.7 (4-6).

Seven individuals (all from farm woodlots in the lowlands) were infested with botflies. One female had two larvae in the rump and five others in various stages of development in the inguinal region.

Populations south of the St. Lawrence River have buffy tones characteristic of *T. s. lysteri* (Richardson) and lack the grizzled gray pelage of *T. s. quebecensis* (Cameron) further to the north, and are referred to the former race.

Specimens collected: St. Anne de Bellevue, 1; Mont Bruno, 1; Mont St. Hilaire, 9; Mont Yamaska, 3; Mont Shefford, 2; Mont Orford, 1; Ayers Cliff, 5; South Bolton, 11; Glen Mountain, 1; Glen Sutton, 1; St. Sebastien, 5; Dundee, 2. Total 42.

Glaucomys volans (Linnaeus). EASTERN FLYING SQUIRREL

This small species of flying squirrel was not found in the study region south of the St. Lawrence River, but it may occur here in the deciduous lowlands. It has been discovered north of the river, however, probably immigrating from Ontario. The Redpath Museum has three specimens from Quebec: Hudson, 2: Isle Perrot, 1.

Glaucomys sabrinus (Shaw). NORTHERN FLYING SQUIRREL

Since only a single specimen was taken, this species is probably uncommon. It was trapped while feeding on a shelf fungus, *Polyporus betulinus*. The forest consisted of mature yellow birch, sugar maple, hemlock, balsam fir and white spruce, at an elevation of 700 feet. The male collected on May 6 had greatly enlarged testes (20 × 9 mm).

Specimens collected: South Bolton, 1.

Castor canadensis (Kuhl). BEAVER

The beaver still persists in this region where relatively isolated waterways are available, particularly in Huntingdon and Brome counties. Habitat destruction and trapping prevent a population increase to former high numbers. Several families were observed in undisturbed ponds and streams in the vicinity of South Bolton. The bark and branches of aspen were preferred as food, and beavers made excursions up to sixty yards into the forest when nearby supplies were exhausted.

Peromyscus maniculatus (Wagner). DEER MOUSE

All wooded habitats harbored the deer mouse, and it was usually the most abundant species present. The greatest numbers were obtained in mature, damp deciduous-coniferous woods: fewer in second growth hardwood or coniferous forest. The species never ventured into grassland but occupied the forest edge, except in the lowlands where it was excluded by the white-footed mouse.

The breeding season extended from mid-April to mid-September. At least two and possibly more annual litters were produced by over-wintering females, and spring-born individuals were sexually active by late July and August. The first evidence of reproduction was noted on April 14 and 16 with four estrous females, April 18 with three females carrying small embryos, and April 26 with a female carrying half-term embryos. Pregnant females were then found in May, 2 animals; June, 2; July, 4; August 4; September, 0. Females revealing placental scars were taken from May to September (2, 3, 3, 10, 1 respectively). The length of testes remained large (8-12 mm) from early April to early September. Seventeen females averaged 5.6 (3-7) embryos per litter, while 18 counts of placental scars averaged 5.3 (4-7).

Specimens collected: Mont Bruno, 1; Mont St. Hilaire, 25; Rougemont, 6; Mont Yamaska, 24; Mont Shefford, 4; Mont Orford, 3; South Bolton, 21; Glen Mountain, 7; Glen Sutton, 2; Mont Echo, 2; Cowansville, 1; Farnham, 2; St. Angele, 3; St. Sebastien, 1; Dundee, 3; Camp de la Roche (Laurentides Park), 3. Total 108.

Peromyscus leucopus (Rafinesque). WHITE-FOOTED MOUSE

The white-footed mouse was present in all seral plant stages from grassland to climax coniferous forest in the St. Lawrence lowlands and Monteregian Hills, but was absent from the more boreal regions to the east and north. Where the two species of *Peromyscus* occurred sympatrically, the white-footed mouse was usually restricted to warm, dry situations (exposed, rocky slopes in pine-northern hardwood forest and forest edge), while the deer mouse selected the cool, moist depths of the forest. Decreasing availability of optimum habitat and competitive exclusion by the deer mouse appeared to be important factors limiting this species' distribution.

The breeding period extended from mid-April to mid-September, during which time several litters were produced. Pregnant females were found in May, 1; July, 1; August, 3; September, 2. Testes remained large and descended throughout the season. Individuals born in the spring were sexually active by early July. Nine litters averaged 4.7 (3-6).

Specimens collected: Mont St. Hilaire, 11; Rougemont, 4; Mont Yamaska, 1; St. Angele, 1; Stanbridge East, 1; St. Sebastien, 1; Dundee, 5. Total 24.

Synaptomys cooperi (Baird). SOUTHERN BOG LEMMING

This species was rare and highly localized in distribution. Intensive trapping in many suitable habitats (damp meadows, bogs, deciduous forest) was usually unsuccessful. Eight specimens were found in a sphagnum-sedge bog in a boreal forest, two in a sedge-mat invaded by low shrubs, and one in a dry field near deciduous woods. One female carried three embryos on August 5.

Specimens collected: Camp de la Roche (Laurentides Park), 8; South Bolton, 2; Total 10.

Clethrionomys gapperi (Vigors). RED-BACKED VOLE

This species was rather scarce during the study period. Not a single specimen was obtained from lowland areas, though local colonies no doubt existed. It was common only at Mont St. Hilaire, where fifteen were collected on a five acre plot in 240 trap nights. The forest was composed of mature beech, maple, red oak, white birch, hemlock and white pine. Moist situations with a good cover of decaying vegetation, rocks or logs were most productive. Red-backed voles were either rare or absent from similar environments on the other Monteregian Hills, and only occasional in the more typical habitat of damp, coniferous-northern hardwood forests at higher elevations.

Pregnant females were found in each month from late April to early September. At least two and possibly more litters were produced annually. In fact, one specimen had placental scars and embryos as early as June 2. The testes remained large (9-14 mm) in males taken from mid-April to mid-September. The average number of young in 20 litters was 4.6 (3-7).

The specimens are referred to *C. g. gapperi* (Vigors) rather than *C. g. ochraceous* (Miller), due to their dark red pelage and small size: total length, 142.1 (131-160); tail, 39.3 (34-50); hind foot, 19.5 (18-20).

Specimens collected: Mont St. Hilaire, 24; Mont Yamaska, 9; Shefford Mountain, 2; Mont Orford, 2; Glen Sutton, 1; South Bolton, 13; Camp de la Roche (Laurentides Park), 6. Total 57.

Microtus pennsylvanicus (Ord). MEADOW VOLE

The meadow vole was unusually scarce, except at Mont St. Hilaire. Dr. Peter Grant and I collected over 100 specimens from a ten acre apple orchard in one summer. The abundance of meadow and red-backed voles at Mont St. Hilaire and a general paucity elsewhere suggested a low in the microtine oscillations for southern Quebec, with the northern populations at Mont St. Hilaire out of phase. Other habitats occupied by this species were moist meadows, grassy drainage ditches, sedge growth around ponds and lakes, and sphagnum bogs.

The breeding season occurred from early April to late September. Two anestrous females were caught on April 14, one pregnant female on May 1, and an estrous individual on May 2. Five pregnancies were noted in June, three in July and one on September 6. Thereafter, adults were barren, though another female showed signs of lactation and recent parturition on September 24. Testes were enlarged (over 10 mm) from early April to late September. Spring-born individuals were sexually active by July. The average number of young in 11 litters was 5.8 (4-9).

Specimens collected: St. Anne de Bellevue, 1; St. Lambert, 1; Mont St. Hilaire, 18; Rougemont, 2; South Bolton, 10; Dundee, 9. Total 41.

Microtus pinetorum (LeConte). PINE VOLE

Peterson (1966) reported a specimen from Pinnacle Mountain, Missisquoi County, the first for Quebec and the most northern record for the species. During the present study two pine voles were collected, from South Bolton and Mont St. Hilaire. The latter record extends the range 38 miles to the north. This microtine is scarce in northern Vermont and New York, and was apparently restricted to a few local colonies in extreme southern Quebec. It may, however, be more common than suspected since its fossorial habits hinder trapping success. Perhaps it occurs still farther to the north-

east, in the St. Lawrence Valley south of the river.

The Mont St. Hilaire specimen was trapped at an exposed den entrance, in open beech, maple, red oak, white pine woods, about twenty yards from a pasture. The soil was moderately dry with little leaf mold present, and only a scant cover of herbs and stumps. The South Bolton specimen was also caught emerging from a tunnel in a rotten stump, two feet inside the woods from a hayfield. The surrounding woods were mixed, but reduced locally to second growth sugar maple. A thick organic layer was present on the forest floor, retaining moisture and supporting numerous herbs. Repeated efforts to collect more pine voles in both areas were unsuccessful.

Specimens collected: Mont St. Hilaire, 1; South Bolton, 1. Total 2.

Ondatra zibethicus (Linnaeus). MUSKRAT

The muskrat was common in streams, ponds and marshes throughout the area, and is trapped for its fur.

Specimens collected: Camp de la Roche (Laurentides Park), 1.

Rattus norvegicus (Berkenhout). NORWAY RAT

This introduced species often occurred in the vicinity of buildings, but was taken under wild conditions only at Rougemont. The site was a drainage ditch, overgrown with cattails and willow, beside a grain field. The nearest farm house was one-half mile away, and it was probably there that the rat colony retired for the winter. It is doubtful that this species could survive the long, cold period without better cover than the summer burrows.

Specimens collected: Rougemont, 3.

Mus musculus (Linnaeus). HOUSE MOUSE

The house mouse was another introduced rodent that invaded grain fields during the summer and returned to human habitations and barns in winter. Specimens were taken at Rougemont in the grain field near where the rats were found, and also at Dundee along grassy drainage ditches, several hundred yards from farm buildings. Native rodents in the same habitat were the meadow vole, white-footed mouse and meadow jumping mouse.

A female collected on September 24 had old placental scars, and taken nearby were five young, probably from its litter. One male had enlarged testes (7.5 mm) on August 30, but those of two adult males collected on September 24 and 25 were reduced (5 mm).

Specimens collected: Rougemont, 2; Dundee, 9. Total 11.

Zapus hudsonius (Zimmerman). MEADOW JUMPING MOUSE

Though *Zapus* was found in a variety of habitats, nowhere was it abundant. Moist situations supporting a thick herbaceous growth, such as meadows, edge of ponds and watercourses, and sphagnum-sedge bogs, appeared optimum. Alder-lined stream banks and the forest-edge (both deciduous and coniferous) were also selected. In the latter three habitats this species was associated with the woodland jumping mouse.

This species was found to be active from May 2 to September 25. One individual was noticeably fat on September 18. An extremely fat female was caught on September 24 at a den entrance on a grassy hummock, which was probably the hibernation site. The next day a smaller, lean female was taken at the same place. Hibernation for the majority of the population probably commenced in early October and extended until late April.

The few data suggested only a spring litter, however, it is possible that at least a few females may reproduce twice annually, as occurs in New York (Connor 1966). Two females carried small embryos on June 21, while another on this date and one on July 17 revealed placental scars. A July 18 specimen showed recent implantation, but no sign of reproducing earlier. Testes of males remained large (over 5 mm) from May 2 to August 30. Two adult females in July and two in September were barren. Four litters averaged six young (5-7).

Specimens collected: St. Anne de Bellevue, 6 (collected by Dr. Peter Grant); South Bolton, 8; Dundee, 3; Camp de la Roche (Laurentides Park), 1. Total 18.

Napaeozapus insignis (Miller). WOODLAND JUMPING MOUSE

This woodland species was absent from the deciduous lowlands, and usually present in small numbers in optimum habitat of herbaceous growth along small mountain streams in deciduous-coniferous woods. At South Bolton, however, it was the most abundant species in the vicinity of a stream

in hemlock-northern hardwoods, with stands of balsam fir and white spruce. Intermittent trapping in three years produced 47 specimens. Other situations supporting small numbers were forest edges, sphagnum bogs invaded by shrubs, and alder thickets lining waterways.

The hibernation period was similar to that of the meadow jumping mouse. One individual emerged unusually early (April 16), and was caught near a stream at Mont St. Hilaire, where there was still a substantial snow cover. The specimen was fat and its stomach contained beech nuts and insects. To determine the time of emergence at South Bolton, where this species was known to be abundant, snap and pitfall traps were set on April 19 and checked daily. Not until the snow had melted and the ground was thawed did *Napaeozapus* appear. On May 6, five males and one female were taken. The last specimen in the fall was captured here on September 7, and th area was not examined again until October 9. Trapping in this and other suitable places failed to reveal their presence. Apparently, most were hibernating by early October and remained below ground until early May.

There is evidence for only a single annual litter in this region. Eight pregnancies were noted from June 4 to 20. Though the testes of males remained large (over 7 mm) from the time of emergence to August. no pregnant females were found during the summer months. Signs of spring reproduction (recent lactation and placental scars) were found in nine adults from July 1 to August 19. Occasional second litters may be produced in southern Quebec, but certainly not with the regularity of populations in the southern part of the range.

Specimens collected: Mont Bruno, 1; Mont St. Hilaire, 2; Mont Yamaska, 9; Shefford Mountain, 2; Mont Orford, 2; South Bolton, 58; Glen Mountain, 1; Glen Sutton, 5; Mont Echo, 2; Camp de la Roche (Laurentides Park), 1. Total 83.

Erethizon dorsatum (Linnaeus). PORCUPINE

The porcupine was scarce in the St. Lawrence lowlands and Monteregian Hills, but locally abundant in the mountains. Over 20 roadkills were recorded in Brome County during the summer months of 1966, and about a dozen live individuals were observed in the vicinity of South Bolton. Many deciduous and coniferous trees were utilized as food. A very young porcupine was discovered on May 6 hiding under a balsam fir.

Specimens collected: South Bolton, 1.

Vulpes vulpes (Linnaeus). RED FOX

Excellent range was afforded this species in southern Quebec's farmlands interspersed with extensive woodlots, and the partly opened forests in the mountains. Most farmers and country residents reported seeing an occasional fox. Three were observed by myself at Mont St. Hilaire, one of which carried a meadow vole and a young woodchuck in its jaws. A food cache consisting of a chipmunk and an immature snowshoe hare was found at South Bolton. Roadkills were noted throughout the area.

Specimens collected: Mont St. Hilaire, 1; (collected by Mr. Henri Ouellet).

Ursus americanus (Pallas). BLACK BEAR

The black bear has been exterminated from most of the area, however, a small number are taken annually by hunters. Game wardens reported a few bears in the wooded regions of Huntingdon and Brome counties. These individuals had probably wandered into this region from adjacent States.

Procyon lotor (Linnaeus). RACCOON

Raccoons were fairly common in woodlots and forests throughout the region. They seemed to congregate in beech and oak woods and also in the vicinity of lakes and streams. Food items determined by observation and analysis of droppings, included berries, apples, mast of beech and oak, frogs, clams, birds' eggs, and rodents.

Specimens collected: 2 mi. S Knowlton, 1; South Bolton, 1. Total 2.

Mustela erminea (Linnaeus). SHORT-TAILED WEASEL

Limited trapping for this species was unsuccessful, as other mammals (usually raccoons) constantly disturbed the traps. The only specimen obtained in this study was shot by Mr. Andre Ouellet in a field near Mont St. Hilaire. Game wardens reported weasels in many areas.

Specimens collected: 2 mi. SE Mont St. Hilaire, 1.

Mustela frenata (Lichtenstein). LONG-TAILED WEASEL

One large male was shot at Mont St. Hilaire, on a rocky slope of hemlock-northern hardwoods. It was hunting among the mossy boulders, and examination of its stomach contents revealed an undigested red-backed vole. Scats were occasionally found along woodland paths; evidence of the general occurrence of weasels in the region.

Specimens collected: Mont St. Hilaire, 1.

Mustela vison (Schreber). MINK

Mink occurred along streams and lake borders in remote areas where trapping pressure had not been excessive. Two animals were observed hunting the riverbanks at South Bolton.

Martes pennanti (Erxleben). FISHER

The fisher has long been extirpated from this region. However, Mr. McGibbon, game warden for Huntingdon County, reported that an increase of fisher in New York had resulted in the appearance of a few animals in traplines from his district. Invasions from the south may now maintain low populations here.

Mephitis mephitis (Schreber). STRIPED SKUNK

The skunk is a common mammal in southern Quebec, and many were observed both alive and as roadkills in all but heavily populated areas.

Lutra canadensis (Schreber). RIVER OTTER

Unfortunatey the otter has almost disappeared from this area. Trappers, game wardens, and local residents reported only an occasional animal.

Lynx canadensis (Kerr). CANADA LYNX

Mr. C. Randall of South Bolton, who used to hunt lynx in the surrounding hills, reported that they had become scarce. Game wardens had no recent accounts of this species, so it is either very rare now or absent altogther.

Lynx rufus (Schreber). BOBCAT

According to game wardens and farmers, the bobcat still persists on extensive farm woodlots and secluded forests.

Odocoileus virginianus (Zimmerman). WHITE-TAILED DEER

Deer have disappeared from extensively farmed and populated areas of the St. Lawrence lowlands, but remain common where forests offer sufficient cover and food. A few data from the 1965 hunting season give some indication of their abundance in the more productive counties: Compton, 560; Brome, 455; Stanstead, 282; Shefford, 270; Missisquoi, 198; Huntingdon, 88; (Report from the Department of Tourism, Fish and Game, Quebec).

Alces alces (Linnaeus). MOOSE

Moose have been drastically reduced in this region for a long time. Several are reported annually in Brome County, which have probably wandered in from the east where this species is more common.

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A CONTRIBUTION TO THE FLORA OF THE SASKATCHEWAN RIVER DELTA

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From spring 1964 to autumn 1968 we studied vegetation-environmental relationships and waterfowl use in the western part of the Saskatchewan River Delta. In the course of the field research we collected vascular plants and bryophytes throughout this 1,100-square-mile (2850 km^2) area, in which the flora had not previously been systematically explored. Extensive use of helicopters and airboats made it possible to visit remote sections of the Delta which otherwise are almost inaccessible.

The Saskatchewan River Delta is botanically interesting because it is floristically richer than the surrounding boreal uplands and marks the western limit of distribution of *Ulmus americana* and *Acer spicatum*.

The Study Area

The investigations were confined to that part of the Saskatchewan River Delta which lies between the Saskatchewan River (Old Channel) and the Carrot River, from their confluence near The Pas, Manitoba, on the east to the connecting Sipanok Channel on the west. The study area thus extends from 53° 30′ to 54° 00′ north latitude and from 101° 18′ to 103° 00′ west longitude (Fig. 1). Most of the collections, however, were made in a 280-square-mile (725 km^2) block in the northern part of the area in which waterfowl food habits research (Dirschl, 1969) and plant ecological studies were also concentrated.

Physiography and Soils

The lower portion of the 40-mile (64 km) wide valley of the Saskatchewan River and its main tributaries, the Carrot and Torch rivers, forms the Cumberland Lake Lowland Division of the Manitoba Lowland Physiographic Region (Acton et al., 1960).

The valley descends in a broad plain from an elevation of approximately 1,100 feet (335 m) above sea level at Nipawin to 852 feet (260 m) in the flood plain at The Pas, where the river has cut a gap through higher morainic deposits to reach Cedar Lake and, eventually, Lake Winnipeg (Ellis and Graveland, 1967).

Geologically, the area is a lacustrine plain, representing the western extension of a series of glacial lakes contemporaneous with glacial Lake Agassiz in Manitoba. This lake plain has been modified greatly by the subsequent activity of the rivers, which have cut valleys through the higher positions of the plain and laid down a pattern of alluvial and flood plain deposits in the lower area. This process of alluvial deposition is still active (Clayton and Ellis, 1952) but is expected to slow, owing to changes in river flows resulting from the upstream Gardiner and Squaw Rapids dams.

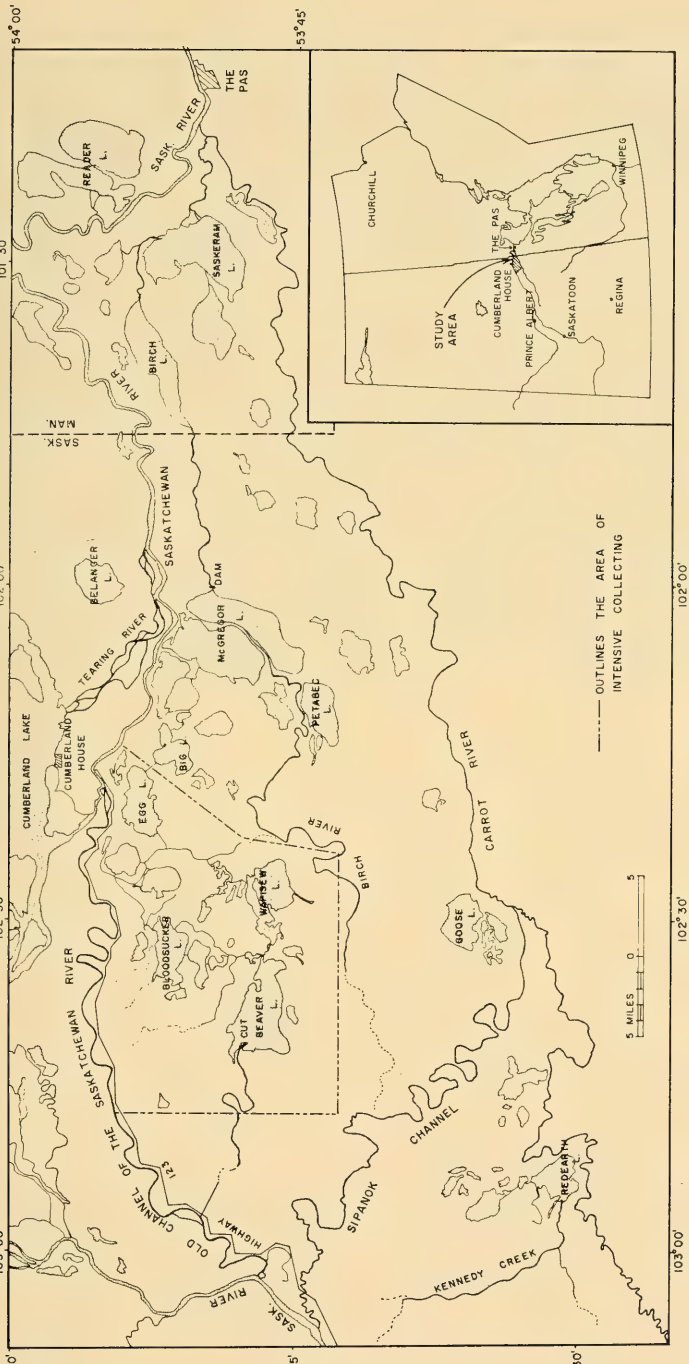

FIGURE 1. Location of the study area in the western part of the Saskatchewan River Delta.

FIGURE 2. View of the alluvial levee of the Saskatchewan River near Cumberland House, showing examples of the following communities: A – *Picea glauca* – hardwoods forest, B – *Populus balsamifera* regeneration, C – *Alnus* – *Salix* shrub, and D – *Carex* fen.

The alluvial-lacustrine plain is flat and lies below the flood levels of the rivers which meander through it. The rivers are bordered by natural levees of alluvium which show little soil profile development, probably because of fluctuating water tables and periodic gleysolic conditions. The dominant soil profile on the levees is a weakly developed wooded calcareous type. In the best drained sites, limited podsolization has led to Dark Gray Wooded and Gray Wooded profiles (Ellis and Graveland, 1967).

Shallow, eutrophic lakes and marshes are surrounded mostly by wide bands of floating sedge mats. Peat, varying in thickness from 1 to more than 12 feet (30.5 cm – 3.7 m), covers the remainder of the flood plain.

CLIMATE

The area lies within the Humid Continental Cool Summer (Dfb) climatic region of the Köppen classification (Atlas of Canada, 1957). Mean annual precipitation at Cumberland House is 17.02 inches (432 mm) – with 10-11 inches (254-279 mm) falling during the growing season – (Ellis and Graveland, 1967) and 15.4 inches (391 mm) at The Pas (Kendrew and Currie, 1955).

Mean monthly January and July temperatures at The Pas are –9°F and 65°F (–22.8°C and 18.3°C), respectively. The summer growing season is short, the mean duration of the frost-free period at The Pas is 102 days

(Kendrew and Currie, 1955). The ground remains frozen for five months in well-drained sites, while muskegs and fens may remain frozen until late July (Dirschl et al., 1967).

MAJOR PLANT COMMUNITIES

Rowe (1959) includes the Saskatchewan River Delta within the Manitoba Lowland Section of the Boreal Forest Region. The Delta contains a great variety of vegetation types, ranging from species-rich moist forest to submerged aquatics, and from acid sphagnum bogs to communities of salt-tolerant plants. Because of the physical nature of the environment in which meandering streams with elevated banks, large shallow lakes, and numerous small water bodies are found in close proximity, the plant communities that developed in response to this broad range of physical habitats form an intricate mosaic.

A brief description of the major phytocoenoses of the Delta will permit a better understanding of the habitat notes in the annotated list of plant species. The communities described are readily recognizable in the field by their physiognomy and, in most cases, they occupy a distinct position in the landscape.

Nomenclature of vascular plants is according to Scoggan (1957), except for the genus *Betula* which follows Dugle (1966). Authority for bryophytes is Bird (1968).

A. LEVEE COMMUNITIES

The alluvial levees of the rivers are the highest and best drained sites in the Delta; in the past they were covered by water only during periods of extreme flood conditions. Two major communities are characteristic of these sites:

(1) *Picea glauca* — hardwoods forest, and
(2) *Alnus - Salix* shrub.

Picea glauca — Hardwoods Forest. Floristically, this is probably the richest forest vegetation in Saskatchewan. Mature, undisturbed stands — dominated by *Picea glauca* up to 100 feet (31 m) high and 27 inches (69 cm) in diameter, by slightly smaller *Populus balsamifera* or, more frequently, by mixtures of both — are among the tallest in the province. (Figs. 2 and 3.) Other common trees are *Acer negundo*, *Betula papyrifera*, *Ulmus americana*, and *Fraxinus pennsylvanica* var. *lanceolata*. Predominant shrubs are *Viburnum trilobum*, *Prunus pennsylvanica*, *Salix discolor*, and *Cornus stolonifera*. Dense ground vegetation is variously dominated by *Ribes* spp., *Equisetum pratense*, *Rosa acicularis*, *Aralia nudicaulis*, and *Matteuccia struthiopteris*.

Alnus - Salix Shrub. This type occurs mainly adjacent to the *Picea glauca* — hardwoods forest in a slightly lower position on the levees. Predominant tall shrubs are *Alnus rugosa*, *Salix discolor*, and *S. bebbiana*. *Cornus stolonifera* and *Viburnum trilobum* are also common. Abundant in the ground vegetation are *Calamogrostis* spp., *Equisetum pratense*, and *Mentha arvensis*.

B. LAKE MARGIN COMMUNITIES

Large portions of the area between the levees and the lake basins are covered by 1 to 6 feet (31-183 cm) of peat, derived from partially decomposed sedges and aquatic plants. Ground water levels remain generally within 1 to 3 feet (31-92 cm) of the surface throughout the growing season. Spring thawing is slow and ice lenses often remain until late July. As a result relatively few shallow-rooted plants are capable of growing in this environment.

In the vicinity of the shores of the present lakes, layers of poorly decomposed peat have been buoyed up and have formed extensive floating mats.

Salix Fen. This community occupies a somewhat lower position in the landscape than the *Alnus-Salix* shrub. The shrub layer consists of willows, generally less than 6 feet (183 cm) tall. *Salix petiolaris*, *S. pedicellaris*, and *S. candida* predominate (Fig. 4). The ground vegetation consists mainly of *Carex* spp., *Naumburgia thyrsiflora*, and *Potentilla pulustris*.

Carex Fen. Closer to the lakeshore, *Salix fens* often grade into open fens, dominated by *Carex* spp. and lacking any shrubby components (Fig. 5). Common species are: *Carex atherodes*, *C. rostrata*, and *Calamogrostis* spp. in the drier areas; *Carex lanuginosa*, *C. aquatilis*, *Equisetum fluviatile*, *Potentilla palustris*, and *Typha latifolia* in wetter locations.

Phragmites Swamp. *Phragmites communis* commonly forms a dense band along the outer edge of the floating mat. It also occurs as an emergent in shallow and wind-protected bays.

C. AQUATIC COMMUNITIES

The floating aquatics *Potamogeton richardsonii*, *P. natans*, *P. pectinatus*, *Nuphar variegatum*, *Myriophyllum exalbescens*, *Ceratophyllum demersum*, and *Utricularia* spp. are abundant in the shallower lakes of the Delta and near the shores of the deeper lakes. *Scirpus validus* and *S. acutus* form dense stands in shallow lakes and along stream banks (Fig. 6). *Sparganium eurycarpum* and *Acorus calamus* are also abundant along the edges of stream channels.

D. BOG COMMUNITIES

In locations of impeded drainage, peat 6-13 feet (1.83-3.97 m) in thickness, has developed. The vegetation of these areas is floristically quite different from that of open drainages.

Picea mariana - *Larix* Bog. This community occurs on deep *Sphagnum* peat whose surface appears to be slightly raised above the surrounding area. The overstory consists of stunted *Picea mariana* with *Larix laricina* usually associated around the edges of the stands (Fig. 7). Tall shrubs are completely absent. Dense ground vegetation is dominated by mixtures of *Ledum groenlandicum*, *Chamaedaphne calyculata*, *Kalmia polifolia*, *Rubus chamaemorus*, and *Oxycoccus quadripetalus*.

Betula glandulifera Shrub. Communities dominated by *Betula glandulifera* are extensive in locations of impeded drainage. In most cases they are found on deep peat in proximity with *Picea mariana* and *Larix laricina* stands.

FIGURE 3. (Above). *Picea glauca* — hardwoods forest stand on the levee of the Saskatchewan River.

FIGURE 4. (Below). *Salix* fen, dominated by *Salix candida* in association with various species of *Carex*.

FIGURE 5. (Above). *Carex* fen, dominated by *Carex lanuginosa*, *Equisetum fluviatile* and *Typha latifolia*.

FIGURE 6. (Below). Emergent aquatic vegetation in a shallow delta lake. Note the typically circular clones of *Scirpus acutus* and the dense cover of floating leaves of *Nuphar variegatum*.

FIGURE 7. (Above). *Picea mariana – Larix* bog on *Sphagnum* peat near the Birch River.

FIGURE 8. (Below). *Betula glandulifera* thicket on deep peat with remnant *Larix laricina* trees.

Betula glandulifera forms dense thickets (Fig. 8). *Myrica gale* is a frequent co-dominant; *Salix candida*, and *S. pedicellaris* also occur commonly. Scattered *Larix laricina* trees and seedlings and a sparse surface cover of *Sphagnum* spp. indicate a seral relationship between the two major vegetation types of impeded drainages.

ANNOTATED LIST OF PLANT SPECIES

The following list is derived from 870 collections which include 58 families, 137 genera, and 231 species of vascular plants, and 14 species of bryophytes.

The identification of most vascular plants has been verified by Dr. G. W. Argus or Mr. J. H. Hudson, University of Saskatchewan. The bryophytes were identified by Dr. C. D. Bird, University of Calgary. Voucher specimens are deposited in the herbarium of the Prairie Migratory Bird Research Centre, University of Saskatchewan Campus, Saskatoon. The numbers used in the species list are herbarium accession numbers. All collections are from Saskatchewan, except those marked specifically to be from the Manitoba portion of the study region.

A. VASCULAR PLANTS

EQUISETACEAE

Equisetum arvense L. Fairly common in *Picea glauca*–hardwood forest. 272.

Equisetum fluviatile L. Common in very wet to submerged habitats. 273-282.

Equisetum hyemale L. var. *affine* (Engelm.) A. A. Eat. In stands of *Picea glauca* on sandy soils. 283.

Equisetum pratense Ehrh. Common on moist banks of streams and canals and associated with levee forest and shrub communities. 284.

OPHIOGLOSSACEAE

Botrychium virginianum (L.) Sw. Collections were taken from stands of *Betula papyrifera* on moist hummocks of stream levees. 516-517.

POLYPODIACEAE

Dryopteris spinulosa (O. F. Muell.) Watt. Collected in a mixed stand of *Abies balsamea* and *Picea glauca* on a well drained stream levee. 556-559.

Matteuccia struthiopteris (L.) Todaro var. *pensylvanica* (Willd.) Morton. A very common fern in the understory of the *Picea glauca*–hardwoods forest. 518, 560-562.

PINACEAE

Abies balsamea (L.) Mill. Occurs in association with *Picea glauca* in a few locations on interior levees. 519-524.

Juniperus communis L. Found in stands of *Picea glauca* growing on thin glacial till over limestone bedrock on Cumberland Island. 525-527.

Juniperus horizontalis Moench. Associated with *J. communis*. 528.

Larix laricina (Du Roi) K. Koch. Generally associated with *Picea mariana* in deep peat areas of impeded drainages. 529-533.

Picea glauca (Moench) Voss. A common tree species on raised levees. 822-883.

Picea mariana (Mill.) BSP. Characteristic tree species of deep peat bogs. 534, 884.

SPARGANIACEAE

Sparganium angustifolium Michx. Not common in the area. Found in shallow water and on floating sedge mat. 782.

Sparganium eurycarpum Engelm. A common species in *Carex* fen communities and in shallow water along creeks and canals. 783-793.

ZOSTERACEAE

Potamogeton filiformis Pers. Collected in shallow bays and shorelines to a depth of about 3 feet (92 cm). 820.

Potamogeton friesii Rupr. Not common. Found in some lakes in the Delta. 821.

Potamogeton natans L. One of the most common pondweeds in the streams and canals; less abundant in still water. 822-830.

Potamogeton praelongus Wulfen. Not common. Found in the deeper lakes. 831.

FIGURE 9. Very old, isolated *Populus deltoides* on the levee of the Saskatchewan River south of Cumberland House.

Potamogeton vaginatus Turcz. Very common in the open water of some lakes 836-839.

Potamogeton richardsonii (Benn.) Rydb. A common plant of streams and shallow open lakes. 832-835.

Potamogeton zosteriformis Fern. Found in both still and flowing water to depths of 4 feet (122 cm). 839-843.

JUNCAGINACEAE

Scheuchzeria palustris L. var. *americanus* Fern. Specimens have been collected in areas of impeded drainage, adjacent to stands of *Picea mariana* and *Larix laricina*; associated with *Betula glandulifera* and *Carex* spp., on floating and anchored *Carex* mats. 430-435.

Triglochin maritima L. Associated with *Betula glandulifera* and *Carex* spp. adjacent to stands of *Picea mariana* and *Larix laricina*. 436-439.

ALISMATACEAE

Alisma triviale Pursh Common in shallow water of creeks and canals throughout the area. 3-7.

Sagittaria cuneata Sheldon. In 4-6 inches (10-15 cm) of water, usually associated with *Carex atherodes* along canals and creeks. 8-13.

HYDROCHARITACEAE

Elodea canadensis Michx. Occurs in most shallow lakes of the Delta. 413-420.

GRAMINEAE

Agropyron trachycaulum var. *glaucum* (Pease and Moore) Malte. Rare. In a *Populus balsamifera* stand on a stream levee, associated with *Cornus stolonifera*, *Ribes hirtellum*, and *Viburnum trilobum*. 315-316.

Agropyron repens (L.) Beauv. On disturbed soil. 317.

Agrostis scabra Willd. Sparse, in moist to wet *Carex* fens. 318.

Beckmannia syzigachne (Steud.) Fern. In mineral soil beside an artificial canal. 319.

Bromus ciliatus L. Collected from dry to moist levees in stands of tall *Salix* or *Populus balsamifera*. 320-322.

Bromus inermis Leyss. Found along dry roadways and cutlines. 323-324.

Calamagrostis canadensis–inexpansa–neglecta complex. Wide-spread collecting has failed to turn up pure parental types. A common grass which grows in a variety of habitats from well drained levees to floating fens. 325-360.

Cinna latifolia (Trev.) Griseb. Collected on alluvium in stands of *Picea glauca*, *Populus balsamifera*, and tall *Salix*. 361-363.

Elymus canadensis L. Found along the highway road allowance. 364-368.

Glyceria grandis Wats. Collected on a portage cutline on the levee of the Saskatchewan River. 369-370.

Glyceria striata (Lam.) Hitchc. Collected in a stand of *Picea mariana* on an old creek levee. Associated with *Equisetum arvense* and *Carex atherodes*. 371-373.

Hordeum jubatum L. Found along road allowance. 374-377.

Muhlenbergia glomerata (Willd.) Trin. var. *cinnoides* (Link) Hermann. Found on wet banks of creeks and canals and in open wet meadows. 378-379.

Phalaris arundinacea L. On mineral soils in moist to wet habitat in stands of *Salix discolor* and *S. bebbiana*. 380-382.

Phleum pratense L. Found along road allowances and cutlines on the levee of the Saskatchewan River. 383-387.

Phragmites communis Trin. var. *berlandieri* (Fourn.) Fern. A very common shoreline plant throughout the Delta. It completely surrounds some of the smaller lakes. 388-390.

Poa pratensis L. Frequent around dwellings on river levees. 392.

Scolochloa festucacea (Willd.) Link. A common species in shallow lakes in the eastern portion of the study area. 393-394.

CYPERACEAE

Eleocharis palustris (L.) R. & S. Common on creek banks and on floating mats. 186.

Eriophorum chamissonis Mey. Collected in a *Picea mariana-Larix* stand, growing in *Sphagnum* moss. 187-189.

Eriophorum gracile Koch. Collected in a saturated *Betula glandulifera* community. 191-193.

Eriophorum spissum Fern. Found in clearings in *Picea mariana-Larix* stands, growing on *Sphagnum* hummocks. 194-199.

Scirpus acutus Muhl. Extensive in open water throughout the delta, in 1.5-5.5 feet (46-168 cm.) of water. 201-202.

Scirpus fluviatilis (Torr.) Gray. In dense stands in water up to 18 inches (46 cm) deep along streams in the Manitoba portion of the study area. 203-206.

Scirpus mcirocarppus Presl. var. *rubrotinctus* (Fern.) Jones. Occasionally found in about 10 inches (25 cm) of water along creeks and canals. 207-208.

Scirpus validus Vahl. Restricted to shorelines, in less than two feet of water, or occasionally in floating *Carex* fens. Also found in shallow moving streams. (Manitoba and Sask.). 209-210.

Carex aquatilis Wahl. In *Carex* fens. 212-221.

Carex atherodes Spreng. Frequent in pure stands in flooded meadows or on floating mats. 222-224, 243-244, 872.

Carex aurea Nutt. Rare on moist peat in a *Betula glandulifera* stand. 225-227.

Carex canescens L. Rare. Occasional on wet banks and floating mats. 228.

Carex chordorrhiza L.f. Collected in a stand of *Betula glandulifera* on deep *Sphagnum* peat. 229.

Carex deweyana Schwein. Occasional on moist, rich alluvium and in dry woods. 230.

Carex diandra Schrank. Collected on a tuft of floating *Phragmites communis* on the north shore of Wapisew Lake. 231-236.

Carex disperma Dew. Uncommon on moist alluvium in *Alnus-Salix and Populus balsamifera* stands. 237-242.

Carex lanuginosa Michx. A common constituent of *Carex* fens in relatively dry locations. 245-251.

Carex lasiocarpa Ehrh. var *americana* Fern. Associated with *Typha latifolia* and *Myrica gale*. 253.

Carex limosa L. Collected from dry *Sphagnum* hummocks at the edge of a *Picea mariana-Larix* community. 254-257.

Carex paupercula Michx. Found on *Sphagnum* in *Picea mariana* bogs. 258.

Carex pseudo-cyperus L. Frequent at lake shorelines in stands of floating *Phragmites communis*. 259.

Carex rostrata Stokes. A common species of very wet *Carex* fens. 260-265.

ARACEAE

Acorus calamus L. In partly submerged *Carex* meadows or in pure stands in open water, 2-3 feet (61-92 cm) deep. 15-19.

Calla palustris L. In shallow, moving water of creeks on the east side of Egg Lake. 20-24.

JUNCACEAE

Juncus nodosus L. Collected on water-saturated mineral soil on the downstream

side of the Birch River Dam, in the area of seepage discharge. 421-429.

LILIACEAE

Disporum trachycarpum (Wats.) B. & H. Rare; occurs in moist forest and tall *Salix* communities of river levees. 471.

Smilacina trifolia (L.) Desf. On *Sphagnum* in stands of *Picea mariana*. 472-476.

Smilacina stellata (L.) Desf. A common though never abundant, plant of moist to saturated mineral soil sites on the levees. 477-482.

SALICACEAE

Populus balsamifera L. One of the most common and widely distributed tree species of the levee forest communities. 664-666.

Populus deltoides Marsh. A single mature tree, approximately 100 feet (30 m) tall, was found on the levee of the Saskatchewan River on the south side of Cumberland Island. The collection was taken from a 30-foot (915 cm)-high sucker, one of ten which surround the parent tree (Fig. 9). 663.

Populus tremuloides Michx. Restricted to very well drained sites on river and stream levees. 667-669.

Salix bebbiana Sarg. A prominent constituent of the *Alnus-Salix* community-type. 670-676.

Salix candida Flügge. Frequent dominant in *Salix* fen communities. 677-686.

Salix discolor Muhl. Occurs in a range of habitats, from the drier *Alnus-Salix* shrub communities to moisture-saturated *Salix* fen. 687-702.

Salix interior Rowlee. Restricted to river banks and sandbars. 703.

Salix lasiandra Benth. Not common. Collections were made in a stand of tall *Salix* on the levee of the Saskatchewan River. 704-705.

Salix lutea Nutt. Rare in the area. 706.

Salix maccalliana Rowlee. Occasionally found in *Salix* fens. 707-708.

Salix pedicellaris Pursh var. *hypoglauca* Fern. Common in *Salix* fens and in bog communities dominated by *Betula glandulifera*. 709-714, 873.

Salix petiolaris Sm. An important constituent of the *Salix* fen community-type. 715-723.

Salix planifolia Pursh. Uncommon in *Alnus-Salix* shrub communities. 724-726.

Salix serissima (Bailey Fern. Often associated with *Betula glandulifera* and *Salix* spp. 727-737.

MYRICACEAE

Myrica gale L. Commonly associated with *Betula glandulifera* and occasionally with *Salix candida* and *S. pedicellaris*. 485-492.

BETULACEAE

Alnus rugosa (Du Roi) Spreng. var. *americana* (Regel) Fern. Abundant on creek and river levees associated with *Salix discolor* and *S. bebbiana*. 33-36.

Betula glandulifera (Reg.) Butler. Found on deep peat in areas of impeded drainage. 37-39.

Betula papyrifera Marsh. Associated with *Picea glauca* and *Populus balsamifera* in mixed forests on river levees. 40-41, 43.

Betula resinifera Britt. In similar habitat. 42.

Corylus cornuta Marsh. Collections are from the well-drained levees of the Birch and Saskatchewan rivers. 44-46.

ULMACEAE

Ulmus americana L. A common constituent of the *Picea glauca*-hardwoods forests of river levees. 794-798.

URTICACEAE

Urtica dioica L. var. *procera* Wedd. Found in dense stands in disturbed locations. 818-819.

SANTALACEAE

Geocaulon lividum (Richards.) Fern. Associated with *Ledum groenlandicum* and *Rubus chamaemorus* on deep *Sphagnum* peat. 738-740.

POLYGONACEAE

Polygonum lapathifolium L. Exists in a wide range of habitat types from dry levees to saturated floating mat. 539-545.

Polygonum amphibium L. var. *stipulaceum* (Coleman) Fern. Common on floating *Carex* mats. 546-551.

Rumex orbiculatus Gray. Collected in a wet *Salix* fen. 552, 555.

Rumex maritimus L. var. *fueginus* (Philippi) Dusén. Rare. Collected in a dense stand of floating *Phragmites communis*. 553.

Rumex mexicanus Meisn. A single specimen collected from a sandy, disturbed site on Cumberland Island. 554.

CHENOPODIACEAE

Chenopodium album L. Collected at the side of the roadway (Mile 55, Highway 123). 94-96.

Chenopodium capitatum (L.) Asch. Collected in an opening in a stand of *Populus balsamifera*. 97-100.

CARYOPHYLLACEAE

Arenaria lateriflora L. In duff under *Alnus-Salix* shrub or mixed forest. 78-83.

Stellaria calycantha (Ledeb.) Bongard. Occasional in moist duff in *Alnus-Salix* communities. 84.

Stellaria longifolia Muhl. Collected in a *Salix discolor* stand, growing in moss, on and around fallen logs. 85-89.

CERATOPHYLLACEAE

Ceratophyllum demersum L. A common aquatic plant, found in the shallow lakes of the delta. 90-93.

NYMPHAEACEAE

Nuphar variegatum Engelm. A very common floating aquatic in most of the lakes and ponds in the western part of the study area, nearly absent in the eastern part. 493-496.

Nymphaea tetragona Georgi subsp. *leibergii* (Morong) Porsild. Common, but not abundant, in some of the shallow lakes. 497-499.

RANUNCULACEAE

Actaea rubra (Ait.) Willd. Frequent in fairly dry sites in *Picea glauca* and tall *Salix* stands. 578-580.

Anemone canadensis L. A common plant in openings of the levee communities. 581-584.

Caltha palustris L. A common early-blooming plant of *Carex* fens and openings in *Alnus-Salix* communities. 585-588.

Ranunculus abortivus L. Rare. Found in moist depressions on alluvium or in disturbed, wet clearings. 589.

Ranunculus aquatilis L. var. *capillaceus* (Thuill.) DC. Common in dense clusters at the water surface in protected bays. 590-593.

Ranunculus circinatus Sibth. var. *subrigidus* (Drew) Benson. Rare. Occurs in sheltered shallow bays of some lakes. 594.

Ranunculus gmelini DC. var. *hookeri* (Don) Benson. Rare on *Carex* mats or stream banks. 595.

Ranunculus lapponicus L. On moisture-saturated sedge and *Sphagnum* peat deposits. 596.

Ranunculus macounii Britt. Common in moist to wet habitats in open stands of tall willows. 597.

Ranunculus pensylvanicus L.f. Found in moist depressions on river levees. 598.

CRUCIFERAE

Brassica kaber (DC.) L. C. Wheeler. In alluvium of disturbed sites. 164-167.

Brassica juncea (L.) Coss. Along road allowance of Highway 123. 168-169.

Cardamine pennsylvanica Muhl. One collection from a cutline through a *Alnus-Salix* community. In 6 inches (15 cm) of water. 170.

Capsella bursa-pastoris (L.) Medic. A weedy species found along disturbed roadways. 171-173.

Erucastrum gallicum (Willd.) O. E. Schulz. Collected from a disturbed site on the levee of the Saskatchewan River. 174-177.

Rorippa islandica (Oeder) Borbas var. *fernaldiana* Butt. and Abbe. Found along roadways. Has also been collected on floating *Phragmites* islands.. 178-182.

Thlaspi arvense L. Collected along a road allowance. 183-185.

SARRACENIACEAE

Sarracenia purpurea L. A very common plant of *Picea mariana-Sphagnum* bogs. 741-743.

DROSERACEAE

Drosera rotundifolia L. Abundant in *Picea mariana-Sphagnum* bogs. 266-268.

SAXIFRAGACEAE

Mitella nuda L. Common in levee forest communities. 744.

Parnassia multiseta (Ledeb.) Fern. In *Carex* fens. 745-748.

Ribes americanum Mill. Abundant on creek and river levees in tall *Salix*, *Picea glauca*, and mixed forest stands. 749-752.

Ribes glandulosum Grauer. In clearings and natural openings on the levees. 753-763.

Ribes hirtellum Michx. Common on all levees. 764-770.

Ribes hudsonianum Richards. Common on all levees. 7771-774.

Ribes lacustre (Pers.) Poir. Common in moist woods and tall *Salix stands*. 775-776.

Ribes oxyacanthoides L. Occurs in most levee communities. 777.

Ribes triste Pall. Common in wooded communities on most of the natural levees. 778.

ROSACEAE

Amelanchier alnifolia Nutt. A common shrub in forest and shrub communities on alluvium. 600-604.

Fragaria vesca L. var. *americana* Porter. Common in duff of *Picea glauca*-hardwoods forest communities. 605.

Fragaria virginiana Duchesne. Collected

under gaps of the canopy of a *Picea glauca-Betula papyrifera* stand on the levee of the Saskatchewan River. 606.

Geum macrophyllum Willd. var. *perincisum* (Rydb.) Raup. Rare. One specimen collected in a moist stand of *Salix discolor* and *S. bebbiana*. 607.

Potentilla anserina L. In disturbed areas on river levees. 608-609.

Potentilla fruticosa L. Found in *Salix* fens and *Betula grandulifera* shrub on deep peat. 610-611.

Potentilla norvegica L. var. *hirsuta* (Michx.) Lehm. Common in disturbed areas and cutlines on river levees. 612-616.

Potentilla palustris (L.) Scop. A common plant of *Carex fens*. 617-623.

Prunus virginiana L. Abundant in the shrub layer of *Picea glauca*-hardwoods forest stands. 624-626.

Rosa acicularis Lindl. Restricted to well-drained levee communities. 627-628.

Rubus acaulis Michx. Found on moist to wet alluvial soils. 629-632.

Rubus chamaemorus L. Generally associated with ericaceaus species in *Picea mariana* bogs. 633-635.

Rubus idaeus L. var. *strigosus* (Michx.) Maxim. Common in forest openings.

Rubus pubescens Raf. Common in moist *Picea glauca*-hardwoods forests. 636-637.

Sorbus decora (Sarg.) *Schn.* Collections taken from mixed forest stands on stream levees, dominated by *Populus balsamifera* or *P. tremuloides*. 638-643.

Spiraea alba Du Roi. Often found in very wet sites along the outside edge of *Salix* fens. 644-651.

LEGUMINOSAE

Astragalus canadensis L. Collected from road allowance on levee of the Saskatchewan River. 453-454.

Vicia americana Muhl. Found in dry to moist sites along the river levees. 460.

ACERACEAE

Acer negundo L. A common tree on the well drained levee of the Saskatchewan River. 1-2.

Acer spicatum Lam. No collection taken. Observed by authors and Dr. G. W. Argus of the Fraser Herbarium, University of Saskatchewan.

BALSAMINACEAE

Impatiens capensis Meerb. In moist habitats, under tall *Salix* or on creek banks. 31-32.

RHAMNACEAE

Rhamnus alnifolia L'Hér. Collected on *Sphagnum* peat in a *Picea mariana* stand. 599.

GUTTIFERAE

Hypericum virginicum L. var. *fraseri* (Spach) Fern. Common in dense *Phragmites* stands, with scattered occurrence in stands of *Betula glandulifera* and *Myrica gale*. 395-407.

VIOLACEAE

Viola renifolia Gray. A single collection taken from an opening in a wet stand of *Salix discolor* and *S. petiolaris*. 816.

Viola selkirkii Pursh. A common plant of the moist forest floor in most levee communities. 817.

ELAEAGNACEAE

Shepherdia canadensis (L.) Nutt. Rare in open areas on river levees. 269-271.

ONAGRACEAE

Circaea alpina L. Common in moist forests, growing in duff or on decomposing logs. 501-504.

Epilobium angustifolium L. Found on cutlines and in disturbed areas around dwellings throughout the area. 505-508.

Epilobium leptophyllum Raf. Collected in *Carex-Equisetum fluviatile* or *Carex-Salix candida* fens in up to several inches of surface water. 509-512.

Epilobium glandulosum Lehm. var. *adenocaulon* (Haussk.) Fern. Collection taken from a cutline through a stand of *Populus balsamifera* on the levee of the Saskatchewan River. 514-515.

HALORAGACEAE

Myriophyllum exalbescens Fern. A common floating plant found in the bays and sheltered shallows of all lakes in the Delta. 408-412.

ARALIACEAE

Aralia nudicaulis L. Common in *Picea glauca*-hardwoods forest throughout the area. 25-30.

UMBELLIFERAE

Cicuta bulbifera L. Found along creeks and canals, collections also taken from *Phragmites* swamps. 799-800.

Cicuta maculata L. Found along water courses and in *Carex* fen communities near lake shores. 801-805.

Heracleum lanatum Michx. Generally found in openings in the moist forest on stream and river levees. 806-810.

Osmorhiza longistylis (Torr.) DC. Not common. Found in *Picea glauca*-hardwoods communities on river levees. 811.

Sium suave Walt. Common in the shallows

of streams and canals and in *Carex* fen communities near lake shores. 812-815.

CORNACEAE

Cornus canadensis L. In *Picea glauca*-hardwoods forests on well drained levees. Associated with *Equiseteum pratense* and *Aralia nudicaulis*. 156-160.

Cornus stolonifera Michx. A very common shrub of levee vegetation throughout the Delta. 161-163.

PYROLACEAE

Moneses uniflora (L.) Gray. In leaf litter under *Picea glauca*. 569-572.

Monotropa uniflora L. Not common. Collected in *Sphagnum* within a stand of *Picea mariana*. 483-484.

Pyrola asarifolia Michx. Sparse in leaf litter in *Populus balsamifera* stands. 573-576.

Pyrola secunda L. Rare. In an open stand of *Picea glauca*. 577.

ERICACEAE

Andromeda glaucophylla Link. Collections were taken from a deep *Sphagnum* peat bog. Plants growing in 6 inches (15 cm) of standing water. 285-287.

Chamaedaphne calyculata (L.) Moench. Collected on *Sphagnum* adjacent to a stand of *Picea mariana* and *Larix laricina*. 288-291.

Kalmia polifolia Wang. Common on *Sphagnum* moss under a *Picea mariana* canopy. 292-296.

Ledum groenlandicum. Oeder. A very common plant on *Sphagnum* moss. 297-304.

Oxycoccus quadripetalus Gilib. Abundant in *Picea mariana* stands on hummocks of *Sphagnum* moss. 305-309.

Vaccinium vitis-idaea L. var. *minus* Lodd. Collected from a *Sphagnum* hummock in a *Picea mariana* bog. 310.

PRIMULACEAE

Naumburgia thyrsiflora (L.) Duby (*Lysimachia thyrsiflora* L.). A common constituent of both *Carex* and *Phragmites* floating mats. 563-566.

Trientalis borealis Raf. Occasional in depressions within *Picea glauca*-hardwoods forest. 567-568.

OLEACEAE

Fraxinus pennsylvanica var. *subintegerrima* (Vahl) Fern. A minor constituent of *Picea glauca*-hardwoods forest communities. 500.

GENTIANACEAE

Menyanthes trifoliata L. Locally abundant at the outer edge of floating mats. Also rooted in 3 feet (92 cm) of water along a creek. 311-314.

APOCYNACEAE

Apocynum androsaemifolium L. Collected from a sandy, disturbed site on Cumberland Island. 14.

BORAGINACEAE

Lappula echinata Gilib. Collection from the road allowance of Sask. Highway 123 at Mile 55. 47.

Mertensia paniculata (Ait.) G. Don. In *Alnus-Salix* shrub on the levee of the Saskatchewan River. 48-53.

LABIATAE

Lycopus uniflorus Michx. Collections were taken from a *Larix laricina* stand, associated with *Equisetum fluviatile*, *Carex atherodes* and *C. aquatilis*. 440-444.

Mentha arvensis L. var. *villosa* (Benth.) Stewart. A common forb of moist to wet *Carex* fens. 445.

Scutellaria galericulata var. *epilobiifolia* (Hamilt.) Jordal. Common in *Carex* fens. 446-447.

Stachys palustris L. var. *pilosa* (Nutt.) Fern. Found in well drained to moist habitat along stream and river levees. 448-452.

SCROPHULARIACEAE

Pedicularis parviflora Sm. Collections taken from a stand of *Betula glandulifera*-*Myrica gale*. 779-781.

LENTIBULARIACEAE

Utricularia intermedia Hayne. Found in the shallow water on and adjacent to floating *Carex* fens. 461-462.

Utricularia vulgaris L. var. *americana* A. Gray. Grows in large masses in shallow, open water. 463-470.

PLANTAGINACEAE

Plantago major L. Found along road allowances and around dwellings in the area. 535-538.

RUBIACEAE

Galium septentrionale R. & S. (*G. boreal*). Common in moist localities. 660-662.

Galium labradoricum Wieg. Usually found in the driest stands of *Picea glauca*-hardwoods forest.

Galium trifidum L. Collected on a moist stream bank in a stand of *Betula papyrifera* and *Populus balsamifera*. 652-653.

Galium triflorum Michx. Common in stands of *Salix discolor* and *S. bebbiana*, and in gaps in mixed forest communities. 654-659.

CAPRIFOLIACEAE

Linnea borealis L. var. *americana* (Forbes) Rehd. On well-drained levees with an overstory of *Picea glauca* or *Abies balsamea*. 56-58.

Lonicera dioica L. var. *glaucescens* (Rydb.) Butters. Infrequent in openings in *Alnus-Salix* shrub and on steep river banks. 59-61.

Lonicera villosa (Michx.) R. & S. var. *solonis* (Eat.) Fern. Common in stands of *Betula glandulifera* in deep peat areas. 62.

Symphoricarpos occidentalis Hook. Abundant on creek and river levees. 63-74.

Viburnum edule (Michx.) Raf. In *Picea glauca*-hardwoods forests. 75-76.

Viburnum trilobum Marsh. A very common plant of the levee communities. 77.

CAMPANULACEAE

Campanula aparinoides Pursh. Frequent in low *Salix* and *Carex* fens. 54.

COMPOSITAE

Achillea millefolium L. Collected from road allowance. 101-102.

Achillea sibirica Ledeb. Associated with *Equisetum pratense* and *Cornus canadensis* on river levees. 103-106.

Aster ciliolatus Lindl. Collected in a stand of *Larix laricina*, associated with *Carex atherodes* and *Equisetum fluviatile*. 107-108.

Aster junciformis Rydb. In exposed sites on creek and river levees. 109-111.

Aster ptarmicoides (Nees) T. and G. Collected near a small lake in deep peat. Associated with *Carex atherodes*, *Naumbergia thyrsiflora*, and *Phragmites communis*. 112.

Aster puniceus L. Occurs in moist openings in low *Salix* communities. 118-119.

Bidens cernua L. A common plant in moist to wet *Carex* fen. 123-124.

Cirsium arvense (L.) Scop. Found along disturbed road cuts. 125-127.

Cirsium muticum Michx. Collected in a dense *Populus balsamifera* stand. 128.

Erigeron philadelphicus L. Fairly common in sunny openings in tall *Salix* stands. 120-122.

Megalodonta beckii (Torr.) Greene. Found only in one location at the east end of Cut Beaver Lake in 2-3 feet (61-92 cm) of water. 129-134. (Only previous collection in Sask. also from this area (Breitung, 1957)).

Petasites sagittatus (Pursh) Gray. Common in 2-4 inches (61-122 cm) of standing water in *Carex* and *Salix* fens. 135-137.

Petasites vitifolius Greene. Collected in a stand of *Picea mariana* south of Cut Beaver Lake. Associated with *Carex atherodes*, *Equisetum arvense*, and mosses on a low creek levee. 138-140.

Senecio eremophilus Richards. Found in an open cutline through a stand of *Populus balsamifera*. 141-144.

Solidago canadensis L. Common in *Calamagrostis*-dominated openings in *Alnus-Salix* stands. 145-148.

Solidago graminifolia (L.) Salisb. var. *major* (Michx.) Fern. In moist to dry sites along canals and openings in forest communities. 149.

Sonchus arvensis L. Collected along road allowance of Highway 123. 151-152.

Sonchus asper (L.) Hill. Common in disturbed habitat throughout the study area. 153.

Taraxacum officinale Weber. A very common weed along roadways and around dwellings. 154-155.

B. BRYOPHYTES

MARCHANTIACEAE

Marchantia polymorpha L. Found with *Campylium chrysophyllum* in a stand of *Phragmites communis*. 845.

SPHAGNACEAE

Sphagnum fuscum (Schimp.) Klinggr. From a hummock in a *Picea mariana* bog. 846-847.

Sphagnum magellanicum Brid. From a hummock in a *Picea mariana* bog. 848-852.

Sphagnum recurvum P. Beauv. Collected from surface of a hollow in a *Picea mariana* bog. 853-856.

DICRANACEAE

Dicranum polysetum Sw. Collected in a *Picea glauca* stand on decayed logs and duff. 869-871.

BRYACEAE

Bryum pseudotriquetrum (Hedw.) Schwaegr. Associated with *Equisetum fluviatile* in a stand of *Larix laricina* and *Betula glandulifera*. 858.

MNIACEAE

Mnium rostratum Schrad. Growing in a depression in a *Picea mariana* bog. 865.

AULACOMNIACEAE

Aulacomnium palustre (Web. & Mohr.) Schwaegr. Collected on a hummock in a *Larix laricina* stand. 857.

AMBLYSTEGIACEAE

Calliergonella cuspidata (Hedw.) Loeske. In a stand of *Phragmites communis* together with *Carex atherodes* and *Hypericum virginicum*. 859-861.

Campylium chrysophyllum (Brid.) J. Lange. In a stand of *Phragmites*, associated with *Impatiens capensis* and *Galium trifidum*.

Drepanocladus aduncus var. *polycarpus* (Bland.) Roth. Found in a variety of wet sites. 862-864.

ENTODONTACEAE

Pleurozium schreberi (Brid.) Mitt. On dry hummocks in *Picea mariana* stands. 874-879.

RHYTIDIACEAE

Rhytidiadelphus triquetrus (Hedw.) Warnst. Found in dry levee forest communities. 880-881.

HYLOCOMIACEAE

Hylocomium splendens (Hedw.) Bry. Eur. Collected in a *Picea glauca* stand on decayed logs and duff. 866-868.

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THE STRIPED SKUNK, *MEPHITIS MEPHITIS* (SCHREBER), IN NOVA SCOTIA

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THE striped skunk was common in Nova Scotia between 1900 and 1930. Thenceforth, it declined, becoming extinct, or nearly so, in many parts of the province in the late 1940's. It has since increased, and appears to be reoccupying its former range.

Gilpin (1870: 63, 65, 67-68) in a paper read before the Nova Scotia Institute of Natural Science in 1868, probably presented the first documentation of the skunk in Nova Scotia. He noted that "Twenty years ago Mr. Downs informed me the skunk was so rare that he had obtained but one skin . . . " Gilpin felt that both the skunk and raccoon were newcomers to the Province yet he recalled "incredible" stories of the Indians "willingly eating the tainted meat." It seems unlikely that such a practice would be developed in a few years.

Piers (1900:13) in a summary of reports noted that W. E. Palfrey advised offering a bounty on skunks in Annapolis County. The same author (Piers 1903:32) states that W. W. Cunnabell of Parrsboro considered skunks as being numerous in Cumberland County. Rand (1933:45) considered the skunk as rather rare in the interior of western Nova Scotia; "preferring the edge of the more settled districts of the Annapolis Valley."

Sheldon (1936:211) reported the skunk as being "better known in the farmlands than elsewhere" and Smith (1940:227) noted that at the time his field studies were conducted (1935:1938) the skunk was most commonly found in the Annapolis Valley. Cameron (1958:14) suggested that the skunk was one of the species likely to colonize Cape Breton Island from mainland Nova Scotia "within the next few years".

Recent History

Skunk fur export figures (Table I) from Nova Scotia are available for most years, 1910-1963 (Annual Reports, Dept. of Lands and Forests). The figure for the report year 1914-1915 was markedly below average. An outbreak of disease in ranch skunks provides a possible clue to the cause. Cruikshank (1915) notes, "We have had no disease of any kind until the present year, or rather the fall of 1914 when an epidemic of distemper broke out in several ranches. It proved fearfully deadly and there seems to be no cure for it. On one ranch only 29 skunks remained of a total of 340 . . . "

If this disease affected wild skunks, as it well may have, both the 1914 and the more recent decline, beginning in the late 1920's could have resulted from a disease organism.

The skunk farming fad died out rather quickly in Nova Scotia, (Table 2), probably as a result of the disease problems. Fur farm permits declined from a high of 40 in 1913-14 to no permits in 1918-19. A total of seven was issued between 1919 and 1922 and none thereafter.

TABLE 1. — Skunk skins exported from Nova Scotia, fiscal years 1910–11 through 1962–63.

Fiscal Year	Skins Exported	Fiscal Year	Skins Exported
1910–11	3613	1937–38	317
1911–12	4813	1938–39	168
1912–13	5467	1939–40	97
1913–14	4570	1940–41	No records
1914–15	255	1941–42	271
1915–16	1004	1942–43	90
1916–17	412	1943–44	143
1917–18	233	1944–45	120
1918–19	1256	1945–46	107
1919–20	1288	1946–47	67
1920–21	1558	1947–48	39
1921–22	2316	1948–49	27
1922–23	3768	1949–50	26
1923–24	3497	1950–51	No records
1924–25	No records	1951–52	13
1925–26	4077	1952–53	11
1926–27	2060	1953–54	8
1927–28	1511	1954–55	8
1928–29	1016	1955–56	1
1929–30	728	1956–57	41
1930–31	501	1957–58	364
1931–32	503	1958–59	1
1932–33	793	1959–60	2
1933–34	262	1960–61	27
1934–35	471	1961–62	5
1935–36	349	1962–63	16
1936–37	541		

A total of 37 completed questionnares received from Dept. of Lands and Forests personnel, trappers and residents throughout the Province provided estimates of the dates of the decline in skunks (Table 3). "Peak" population years were given in Yarmouth and Digby Counties as 1914-1920, Annapolis 1915, Colchester 1915-1932, Lunenburg 1905, and Pictou 1920-1930. Dept. of Lands and Forests Annual Reports note skunks as declining in most counties in 1937, 1938, and 1946-1950. In 1951 the report states "skunks, which almost disappeared from the Province are becoming more noticeable in Cumberland and Colchester Counties, and have been observed in other areas, such as Pictou County near Glasgow, and toward Halifax near Lantz." Figure 1 indicates county and place locations named.

The data suggest a general decline beginning in the western end of the Province about 1925 and moving eastward reaching possible "lows" in northern and eastern mainland areas in the mid 1940's.

Present Status

The seven eastern mainland counties of the Province are known to have skunks present. Except for two observations of skunks dead on the highway in central Kings County, reported by Provincial Forest Ranger S. L. Parks in August 1963, the western-most report received has been from Falmouth, Hants County. The approximate westward boundary for the skunk in 1966 is

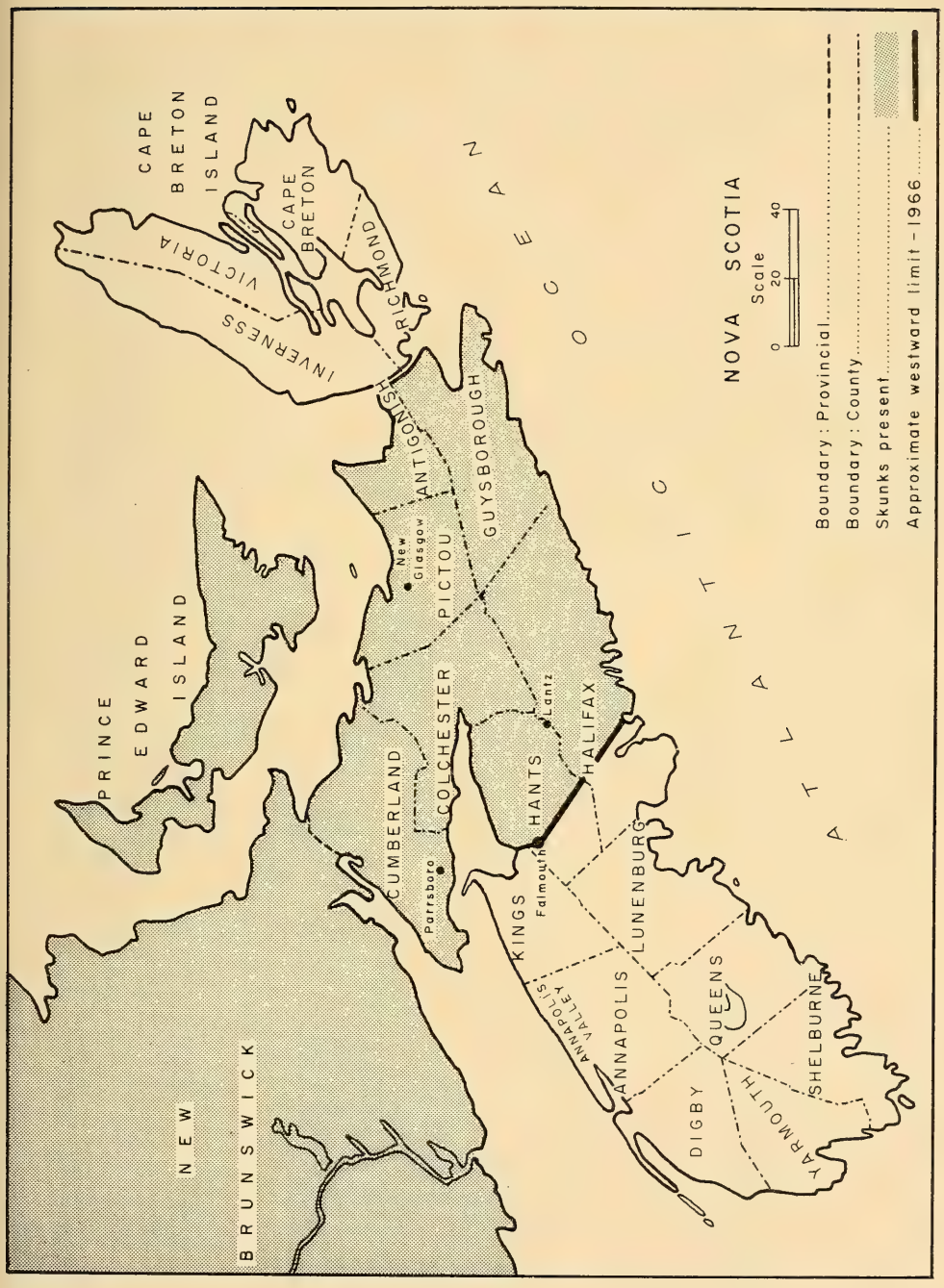

FIGURE 1. Distribution of Skunks in Nova Scotia.

TABLE 2. — Skunk ranching data in Nova Scotia, 1914–1919.

Year	Captivity	Sold	Died	Exported	Total
1914	647	621	120	102	1490
1915	598	39	489	159	1276
1916	262	24	147	112	545
1917	37	1	12	8	58
1918	0	0	0	0	0
1919	4	0	0	0	4
Total	1548	685	768	381	3373

shown on Figure 1. Skunks are not yet known to be present on Cape Breton Island.

Populations tend to be concentrated about a few centers throughout the eastern mainland. The farming areas of Cumberland, Colchester, Pictou and Antigonish Counties have the highest densities while Guysborough, Halifax, and Hants Counties indicate scattered, low density populations. In 1964 I received reports of 50 skunk observations from 15 Provincial Forest Ranger questionnaires in the seven counties. Since 1960 I have personally observed either live or dead skunks on highways in Hants, Colchester, Cumberland, Pictou, and Antigonish Counties and in the woods of Guysborough County.

In 1964 the questionnaires suggested static populations in Cumberland, Pictou and Guysborough with possible increasing populations in Colchester, Halifax and Hants Counties.

It appears that skunks were completely lost from all the western portion of the Province and probably much of the eastern mainland – existing in low numbers in the counties of Cumberland, Colchester, and Pictou at the bottom of the fluctuation. They are however, gradually returning westward and seem to be moving through the farming regions of the northern counties more rapidly than through the forested, non-farm southern counties.

TABLE 3. — Years of decreasing population density in Nova Scotia as reported from questionnaires

County	Estimated Years of Decline
Yarmouth	1917 and again after 1925
Digby	Same as Yarmouth
Shelburne	1930–36
Queens	1930–35
Annapolis	1926–30
Kings	After 1935
Halifax	"Gone" by 1940
Hants	1925–1940
Colchester	1933–1945
Pictou	1931–1944
Guysborough	"Lowest" 1946

All questionnaires completed by Forest Rangers in the western counties indicated an absence of skunks for several years. In extensive coverage of much of this back country since 1960 I have observed no sign of skunks and personal interview with residents throughout western Nova Scotia has provided only negative results. The complete lack of any positive information for several years suggests that skunks probably do not occur in western Nova Scotia now.

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STUDIES OF THE BYRON BOG IN SOUTHWESTERN ONTARIO XXXIX. INSECTS TRAPPED IN THE LEAVES OF SUNDEW, *DROSERA INTERMEDIA* HAYNE AND *DROSERA ROTUNDIFOLIA* L.

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THE BYRON BOG has been described by Judd (1957). Its central part is a floating mat of *Sphagnum* moss. On this mat grows the pitcher-plant, *Sarracenia purpurea* L. A study of the insects found in the leaves of this plant was conducted in 1956 and reported on by Judd (1959). Also on the mat grow two other carnivorous plants, the Spatulate-leaved Sundew, *Drosera intermedia* Hayne and the Round-leaved Sundew, *Drosera rotundifolia* L. *D. intermedia* is more abundant than *D. rotundifolia* for it grows in extensive patches on the *Sphagnum* mat, while *D. rotundifolia* is more scattered and grows on the sides of cushions of *Sphagnum*. Charles Darwin (1898) in the opening sentence of his "Insectivorous Plants" said "During the summer of 1860 I was surprised by finding how large a number of insects were caught by the leaves of the common sun-dew (*Drosera rotundifolia*) on a heath in Sussex" and proceeded to give an account

of many subsequent original observations on the insectivorous habits of this plant. Lloyd (1942) brought together observations on the habits of *Drosera*, including several by Darwin.

On August 12, 1967 collections were made of insects trapped in the leaves of *D. intermedia* and *D. rotundifolia* in the Byron Bog. There was no wind, the temperature was 75°F, and the sky was clear except for the presence of scattered cumulus clouds. During the afternoon plants of the two species were scanned closely and any leaf on which part of the blade was rolled, or the tentacles were bent over the blade, was snipped from the plant and examined with a hand lens. Several leaves had small portions of fronds of *Sphagnum* moss trapped by the tentacles. Darwin (1898) points out that "if a bit of dry moss, peat or other rubbish, is blown onto the disc, as often happens, the tentacles clasp it in a useless manner." Fifty leaves were found clasping dead insects. These were carefully removed and pinned or preserved in fluid and were identified by the following taxonomists all of whom, except V. R. Vickery, are members of the staff of the Entomology Research Institute, Department of Agriculture, Ottawa: D. Brown (Hemiptera, Homoptera), R. deRuette (Coleoptera), R. V. Peterson (Chloropidae, Pipunculidae, Scatopsidae), W. R. Richards (Aphidae), H. J. Teskey (Tipulidae), V. R. Vickery, Macdonald College, Quebec (Gryllidae), J. R. Vockeroth (Anthomyzidae, Muscidae). All the specimens are in the collection of the Department of Zoology, University of Western Ontario except some noted as "kept" in the Canadian National Collection. Many of the insects were too greatly dismembered to be recognized but several were identified to genus and species. As will be seen in the following account, several of them are species which have been found previously in the bog in various habitats, particularly on bushes of leather-leaf, *Chamaedaphne calyculata* and in Redmond's Pond, a permanent pond in the *Sphagnum* mat. Table I shows what insects were collected.

Account of Insects Collected

As many as three insects were found in one leaf, as exemplified by three *Oscinella* sp. in a leaf of *D. intermedia*. Darwin (1898) records that as many as thirteen insects were found in a single leaf of *D. rotundifolia*. The presence of 47 flies in the leaves, about three-quarters of the total catch, is in accord with the observation of Darwin (1898) that "flies (Diptera) are captured much oftener than other insects." In the trapping of an insect by *D. rotundifolia* the blade of the leaf remained flat and the tentacles alone closed over the insect. In *D. intermedia* the tentacles closed over the insect and in addition, in some cases, the tip of the leaf curled downward along the length of the leaf, thus enclosing the insect in a cylindrical roll formed by the blade of the leaf. This latter observation is in accord with the report on *D. intermedia* by Darwin (1898) that the "apex of the leaf curls over an exciting object." Many more leaves of *D. intermedia* than of *D. rotundifolia* were found clasping insects, this difference being probably a reflection of the greater abundance of *D. intermedia* as compared with *D. rotundifolia*.

TABLE 1. — Insects trapped in fifty leaves of *Drosera*

Order	Family	Name	Number of leaves of *Drosera*		Number of Insects
			intermedia	*rotundifolia*	
Orthoptera	Gryllidae	*Nemobius* sp. (nymph)	1		1
Coleoptera	Dytiscidae	*Hydroporus* sp.	1		1
	Helodidae	*Cyphon* sp.	4		4
Hemiptera	Saldidae	*Saldula orbiculata*	1		1
		Micracanthia ?humilis	2		2
	Miridae	*Plagionathus* sp.	1		1
Homoptera	Cicadellidae	unidentified hopper	1		1
		Macrosteles sp.	1		1
		Scleroracus sp.	1		1
	Aphidae	*Rhopalosiphum maidis*	3		3
		Aphis ?fabae	1		1
Diptera	Chironomidae	unidentified midges	7	1	9
	Tipulidae	*Erioptera uliginosa*	1		1
		Erioptera ?caloptera	1		1
		?Erioptera sp.	1		1
	Mycetophilidae	*Macrocera* sp.	1		1
	Scatopsidae	*Scatopse fuscipes*		1	1
	Pipunculidae	*Pipunculus* sp.		1	1
		unidentified fly	1		1
	Chloropidae	*Oscinella* sp.	2		4
	Anthomyzidae	*Cyamops nebulosa*	1		1
	Muscidae	*Coenosia tigrina*	1		1
	Unidentified flies		14	3	25
TOTALS			47	6	64

Forty-four leaves of *D. intermedia* and six leaves of *D. rotundifolia* held a total of 64 insects. Three leaves of *D. intermedia* held two different species of insects: 1 *Rhopalosiphum maidis* and 1 chironomid fly; 1 *Cyphon* sp. and 1 unidentified fly; 1 *Oscinella* sp. and 1 chironomid fly. Thus the total of forty-seven leaves reported for *D. intermedia* in Table I represents the forty-four leaves of this species holding insects. Other insects caught in leaves of *D. intermedia* were distributed as follows: thirty-two leaves with 1 insect each; seven leaves with 2 unidentifiable flies each; one leaf with 2 chironomid flies; one leaf with 3 *Oscinella* sp. In the leaves of *D. rotundifolia* the insects were distributed as follows: five leaves with 1 insect each and one leaf with 2 unidentified flies.

ORTHOPTERA

Gryllidae

Nemobius sp. — 1 nymph. Dr. Vickery, in identifying the nymph, pointed out that it was in the first or second instar and was probably *N. palustris*, a species confined to *Sphagnum* bogs (Vickery and Kevan, 1967).

COLEOPTERA

Dytiscidae

Hydroporus sp. — 1 adult. Several species of this genus of beetle were collected perviously from Redmond's Pond by Judd (1968).

Helodidae

Cyphon sp. — 4 adults. Several beetles of this genus were collected previously from leaves of leather-leaf by Judd (1960).

HEMIPTERA

Saldidae

Saldula orbiculata (Uhler) — 1 shore bug. Bugs of hte genus *Saldula* were found pre-

viously on Redmond's Pond (Judd, 1961).
Micracanthia ?humilis (Say) — 2 shore bugs. Usinger (1956) reports that bugs of the genus *Micracanthia* inhabit bogs.
Miridae
Plagiognathus sp. — 1 plant bug. *P. repetitus* Knight occurred commonly on leather-leaf in 1956 (Judd, 1960).

HOMOPTERA

Cicadellidae
Macrosteles p. — 1 leaf hopper. Hoppers of this genus are present on leather-leaf in the bog (Judd, 1960).
Scleroracus sp. — 1 leaf hopper. Two species of this genus occur commonly on leather-leaf in the bog (Judd, 1960).
One unidentified leaf hopper was found in a leaf.
Aphidae
Rhopalosiphum maidis (Fitch) — 3 aphids. This is the Corn Leaf Aphid (Archibald, 1958).
Aphis ?fabae Scopoli — 1 aphid. *A. fabae* is reported by Archibald (1958) to winter on high bush cranberry and strawberry bush, both of which are shrubs found in the bog (Judd, 1966).

DIPTERA

Chironomidae
Nine unidentified midges were found in the leaves. Several species in this family form a large part of the population of insects in Redmond's Pond (Judd, 1961).
Tipulidae
Erioptera uliginosa Alex. — 1 cranefly (kept). This species was found previously in the bog by Judd (1960).
Erioptera ?caloptera Say — 1 cranefly.
Erioptera sp. — 1 cranefly.
Mycetophilidae
Macrocera sp. — 1 female fungus gnat. A fly of this genus was found previously in the bog by Judd (1960).
Scatopsidae
Scatopse fuscipes Meigen — 1 fly. This species is widely distributed in North America and the larvae live in decaying plant material and animal excreta (Stone *et al.*, 1965).
Pipunculidae
Pipunculus sp. — 1 fly. This fly was in a leaf of *D. rotundifolia* and another pipunculid fly of unknown genus was in a leaf of *D. intermedia*. Flies of this family are parasites of Homoptera, many species of which occur in the bog (Judd, 1960).
Chloropidae
Oscinella sp. — 4 flies (kept). One species of *Oscinella* has been found on leather-leaf in the bog (Judd, 1960).
Anthomyzidae
Cyamops nebulosa Mel. — 1 male (kept). Flies of this family are taken commonly from grass and low vegetation, especially in marshy areas (Stone *et al.*, 1965).
Muscidae
Coenosia tigrina (Fab). — 1 female. Several species of *Coenosia* have been found in the bog (Judd, 1960), including *C. tigrina* from Redmond's Pond (Judd, 1961).

In addition to the flies identified above, twenty-five dismembered and unidentified flies were found in the leaves.

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GREAT BLUE HERON COLONIES IN ALBERTA

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A SURVEY of nesting colonies of Great Blue Herons (*Ardea herodias*) was made in Alberta from May to August, 1967, as part of a Canadian Wildlife Service program to protect endangered birds. Most heronries were located by asking biologists, wardens, and naturalists if they knew of nesting colonies in their areas. A few others were found by searching apparently suitable habitat along rivers and around lakes. A few colonies may have been missed as the survey was not exhaustive. A heronry of 11 active nests, situated in low willow bushes on an island at Dowling Lake, was studied in 1968 because of its accessibility. This colony was visited twice or four times a week during April, twice or three times a week in May, and once a week in June and July of 1968.

Most heronries are located in the southern half of the province as shown in Figure 1. Numbers and letters in that figure corespond to the active and extinct nesting colonies shown in Tables 1 and 3 respectively. All colonies were near water, probably on account of the feeding habits of the herons. Cottam and Uhler (1945) found that 189 stomachs of Great Blue Herons collected throughout the United States contained mostly fish and aquatic arthropods. Of the 35 active and extinct colonies, 19 were located on lake islands, 4 near lake shores, and 12 near rivers or creeks. The preference for nesting in the tops of trees (Table 2) and on lake islands rather than on lake shores is probably a mechanism to avoid mammalian predation. The two heronries below 20 feet (Table 2) were located on islands. Behle (1958) found Great Blue Herons nesting on the ground and in greasewood bushes on several islands in Great Salt Lake, Utah. Lahrman (1957) observed Great Blue Herons nesting on the ground on an island in Old Wives Lake, Saskatchewan. Predation is probably minimal on island heronries.

TABLE 1. — Location and size of Great Blue Heron colonies in Alberta in 1967

Water body	No. nests	Section	Township	Range
1. Arthur Lake	44	22	55	5W5
2. Baker Creek	14	33	18	29W4
3. Battle River	12		41	17W4
4. Battle River	30	12	45	23W4
5. Beaverdam Creek	33	21	28	3W5
6. Belly River	55	22	4	27W4
7. Bow River	18	35	21	25W4
8. Bow River	34	23	21	26W4
9. Buffalo Lake	7	26	40	21W4
10. Chip Lake	36	17	54	10W5
11. Dowling Lake	11	7	32	14W4
12. Frenchman Lake	7	16	64	10W4
13. Frog Lake	45	27	57	3W4
14. Honeymoon Lake	5	13	36	26W4
15. Island Lake	1	1	68	24W4
16. Islet Lake	8	1	52	20W4
17. Jamieson Lake	15	35	43	7W4
18. Lower Mann Lake	13	1,12	60	11W4
19. Meyer Lake	17	23	69	24W4
20. Murray Lake	30	26	9	8W4
21. Oldman River	14	1	11	19W4
22. Pelican Lake	35	8	79	21W4
23. Red Deer River	32	28	21	12W4
24. Schroeder Lake	18	12	37	26W4
25. Thunder Lake	14	30	59	5W5
26. Trout Creek	12	34	11	28W4
27. Unnamed pond	14	20	55	1W5

Great Blue Heron colonies are chiefly situated in western cottonwoods (*Populus sargentii*) below 51° latitude, in balsam poplars (*P. balsamifera*) between latitudes 51° and 54°, and in balsam poplar and spruce (*Picea* spp.) above 54° latitude in Alberta. Behle (1958) reports Great Blue Herons nesting in cedars, greasewoodbushes, hawthorne and willow thickets, and in hardstem bulrush two to four feet above shallow water in Utah. The selection of certain nesting trees probably depends on their proximity to water, availability, height, and tree-structure which facilitates building of nests.

Great Blue Herons frequently nest in dead trees, and the birds' excrement probably contributes to the death of the tree. Active and inactive nests of herons were found in dead trees which had been blown over in several colonies. Colony sites may disappear in this fashion. R. Underwood (pers. comm.) informed me that the nesting trees in the island heronry at Honeymoon Lake decayed and that the herons moved consequently to nest at the shore of that lake and 5.5 miles north to an island in Schroeder Lake. Munro (1929:200) reports of the heronry at Ministik Lake in 1924: "Some of the nesting trees had fallen and many others were dead or dying". Farley (1919) found that a heronry originally discovered in trees on a 2-acre island in Miquelon Lake in 1908 had disappeared ten years laters. He reported: "All the trees had fallen and the entire surface of the island was covered with nettles".

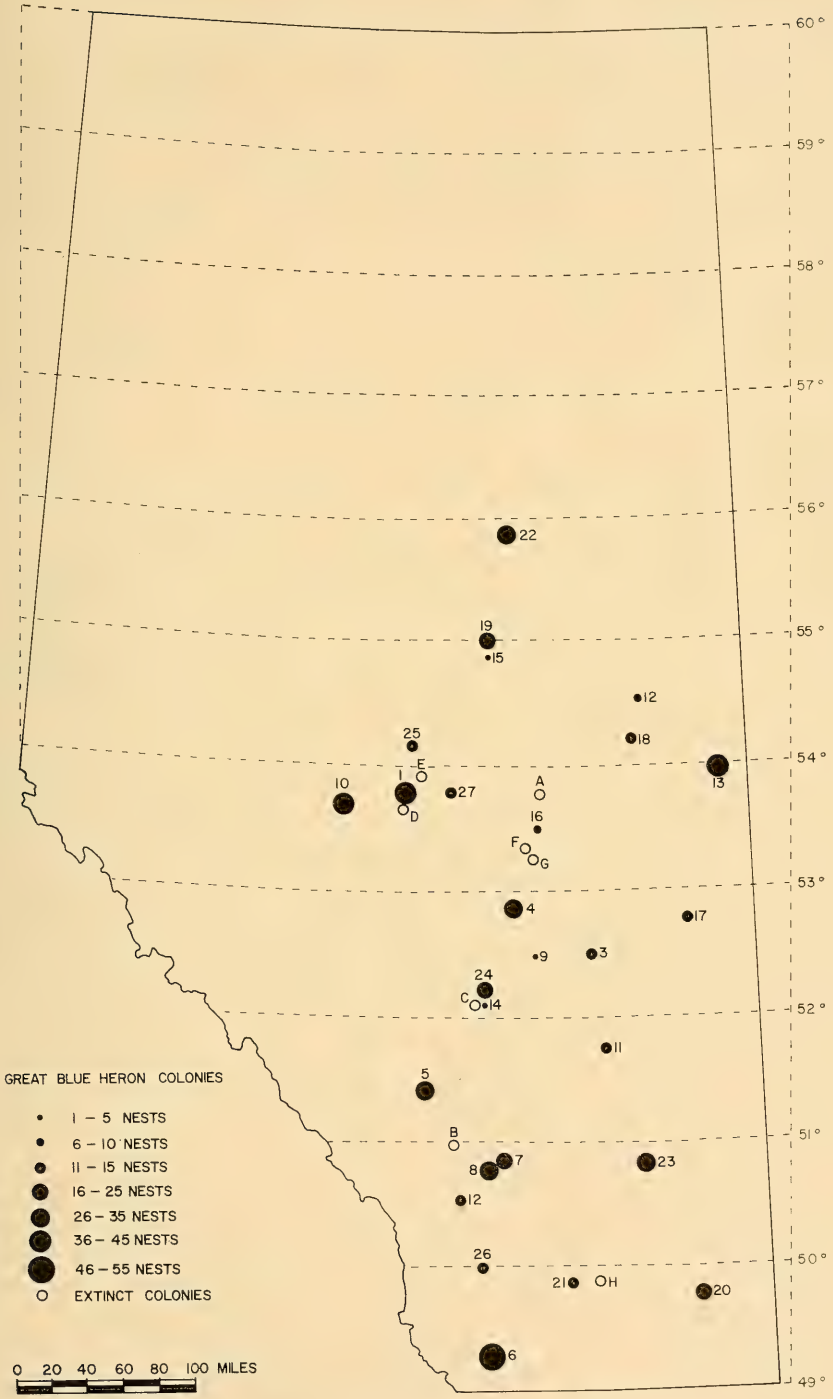

Figure 1. Distribution and size of of Great Blue Heron colonies in Alberta in 1967.

TABLE 2. — Tree habitat of active Great Blue Heron colonies

Dominant tree species in colony	Prevalent condition of nesting trees			Estimated average height in feet			
Species	No. colonies	Alive	Dead	1–10	11–20	21–30	>30
Populus spp.[a]	19	12	5		1	1	17
Picea spp.[b]	5	3	2			1	4
Acer negundo	2	2				2	
Salix sp.	1	1		1			
Total	27	18	7	1	1	4	21

[a]mostly *Populus balsamifera* and *P. sargentii*
[b]*Picea glauca* and *P. mariana*

Two Great Blue Heron colonies had disappeared as a result of vandalism (Table 3), and some of the active heronries are presently suffering the same fate. G. W. Meyer (pers. comm.) informed me that 12 herons were shot at the colony at Island Lake in 1965, resulting in a decline from 10 active nests in that year to one nest in 1967. He also stated that the herons moved 9 miles north of Island Lake to nest on a peninsula in Meyer Lake. According to W. Uhl (pers. comm.), about 15 herons were shot in the colony at Trout Creek in 1963. It appears that some measure of protection is needed to prevent a similar fate occurring to other heronries in Alberta.

Some old heron nests may be taken over by other birds. Three at Dowling Lake contained eggs of Canada Geese (*Branta canadensis*). C. Gordon (pers. comm.) found 17 occupied by Canada Geese in a now extinct colony on the Bow River. House sparrows (*Passer domesticus*) were found nesting in the base of heron nests in four fallen trees. Palmer (1962) reported large hawks, owls, and vultures commonly nesting in heronries.

All but one heronry contained only Great Blue Herons. A mixed colony of 30 and 20 nests of Great Blue and Black-crowned Night Herons (*Nycticorax nycticorax*), respectively, was found in boxelder trees (*Acer negundo*) near Murray Lake. That is the first record of Black-crowned Night Herons nesting

TABLE 3. — Causes of the loss of Great Blue Heron colonies

Colony location	Cause of decline	Source
A. Astotin Lake	unknown	Soper, 1940
B. Bow River	vandalism	C. Gordon (pers. comm.)
C. Honeymoon Lake	trees decayed	R. Underwood (pers. comm.)
D. Isle Lake	vandalism	D. Unger (pers. comm.)
E. Majeau Lake	fire	Soper, 1939
F. Ministik Lake	trees decayed	Munro, 1929
G. Miquelon Lake	trees decayed	Farley, 1919
H. Oldman River	trees cut	C. Gordon (pers. comm.)

TABLE 4. — Spring arrival and distribution of clutch initiation of Great Blue Herons at Dowling Lake in 1968

Spring arrival		Clutch initiation	
Date of observation	No. of herons observed	Date of clutch initiation[a]	No. of clutches initiated
March 30	0	April 26	1
April 8	1	,, 27	1
,, 10	1	,, 28	1
,, 12	1	,, 29	1
,, 14	1	May 1	1
,, 16	2	,, 3	1
,, 18	5	,, 5	1
,, 22	7	,, 8	1
,, 26	9	,, 10	2
,, 29	11	,, 24	1
May 3	17	June 1	1

[a]Estimated to within one day

in trees in Alberta. Several other nesting colonies of that species have been found in marsh vegetation there (Wolford, 1966).

In 1968, a Great Blue Heron colony with 11 active nests at Dowling Lake was studied in more detail. The spring arrival and clutch commencement of the herons at this colony are shown in Table 4. The clutch initiated on May 24 may have been delayed because a pair of Canada Geese occupied this nest previously in that month. The clutch initiated on June 1 is thought to be replacement, since the initial clutch in the same nest failed. The time interval between the laying of successive eggs in a clutch, incubation period, clutch size, and age at first flight of the herons at Dowling Lake are shown in Table 5.

There were originally 55 eggs in 11 clutches but one egg each was taken from 10 nests for a pesticide analysis of their contents. The remaining 45 eggs resulted in 20 fledglings. Extrapolating from these eggs left in the nest, the original 55 eggs would probably have resulted in 24 or 25 fledglings which is an average success of 2.2 or 2.3 fledglings per nest. Fledglings were counted in 92 nests of Great Blue Herons in Alberta in 1967. The average success was 2.5

TABLE 5. — Egg-laying intervals, incubation period, clutch size, and age of first flight of Great Blue Herons at Dowling Lake

	Sample size	Mean	Range
Egg laying interval	14 intervals[a]	2 days	2 days
Incubation period	6 periods[a]	26.7 days	26–27 days
Clutch size	11 clutches[b]	5.0 eggs	4–6 eggs
Age at first flight	7 periods[c]	52.6 days	51–54 days

[a]Estimated to within one day
[b]Replacement clutch of 3 eggs which failed, excluded
[c]First flight occurred when startled on nest

TABLE 6. — Fledging success observed in 92 nests of Great Blue Herons in Alberta in 1967

No. fledglings per nest	No. nests
1	8
2	39
3	35
4	10
Mean fledging success per nest 2.5	

fledglings per nest that year (Table 6). Hence the fledging success of the herons at Dowling Lake in 1968 was similar to that in several heronries in Alberta in 1967.

All young herons at Dowling Lake could fly by August 1. Some kept visiting the nest after fledging as five young herons were still observed on the nests by August 8.

SUMMARY

All Great Blue Heron colonies were situated near water, with most on lake islands. Disappearance of some heronries resulted from decay of nesting trees and vandalism. The egg-laying interval averaged 2 days, the incubation period 26.7 days and the age at first flight for Great Blue Herons averaged 52.6 days. The mean clutch size was 5.0 eggs. The average fledging success in 92 nests in heronries throughout Alberta consisted of 2.5 fledglings in 1967.

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EUPHORBIA × *PSEUDO-ESULA* (*E. CYPARISSIAS* × *E. ESULA*) IN CANADA

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The occurrence of *Euphorbia* × *pseudo-esula* Schur in North America has not yet been reported in floras. This hybrid between *E. cyparissias* L. (Cypress Spurge) and *E. esula* L. (Leafy Spurge) has recently been collected at three widely-separated locations in Ontario.

Cypress Spurge and Leafy Spurge are European introductions of common occurrence in some areas of Canada. In Ontario, Cypress Spurge is widespread and is a serious weed in some districts. Two chromosome races ($2n=20$, $2n=40$) of *E. cyparissias* are present; the diploid plants of Ontario are seed sterile, due to pollen abortion but tetraploids are highly fertile (Moore & Lindsay, 1953). The chromosome number of *E. esula* is $2n=60$ (Moore, 1958). *Euphorbia esula* is less common in Ontario but is abundant and weedy in the Prairie Provinces.

An artificial hybrid between *E. esula* and a tetraploid plant of *E. cyparissias* was made in a previous study (Moore, 1958). The hybrid was intermediate in appearance and in chromosome number ($2n=50$). The natural hybrid has been frequently reported in Europe, from central and southern Germany, northern Austria, Hungary and Roumania. It has been called *E.* × *pseudo-esula* Schur and *E.* × *figertii* Dörfler; the former name has priority.

Occurrence in Canada

The natural hybrid has been found in the following three locations in Ontario. Specimens are preserved in the herbarium of the Department of Agriculture, Ottawa (DAO). The chromosome counts reported here were made by the senior author from root tips of plants collected at the locations stated and subsequently cultivated in the greenhouse.

HURON CO., Bluevale – collected by J. Parmelee and D. B. O. Savile in 1957 while on a mycological survey. A living plant was collected and from this the chromosome number $2n=50$ was determined. Tetraploid *E. cyparissias* was found in the same area. The occurrence of the hybrid and its chromosome number was reported by Parmelee (1962).

BRUCE CO., 3½ miles south of Sauble Beach, *G. A. Mulligan & R. J. Moore 2650*, July 28, 1962. Numerous plants were scattered through woods along the highway. Very few plants bore any seed.

MUSKOKA CO., just west of Port Sydney, *C. & E. G. Frankton 2085*, July 29, 1968. An ungrazed field near the highway contained the hybrid and also *E. cyparissias* (*C. & E. G. Frankton 2083*) and *E. esula* (*C. & E. G. Frankton 2084*). Chromosome numbers were determined as: *E. cyparissias*, $2n=40$; *E.* × *pseudo-esula*, $2n=50$.

[1]Contribution No. 717 of the Plant Research Institute.

MORPHOLOGY

Photographs of the artificial hybrid were previously published (Moore, 1958). One of the natural hybrids is shown in Fig. 1. Hybrids are intermediate between the parents in height, in abundance and size of the cauline leaves and in arrangement of the flowering rays. The flowering rays bearing the cyathia may be aggregated into a terminal umbel or occur singly in the leaf axils, along the stem. In *E. cyparissias*, all rays are usually collected in the terminal umbel but occasionally a few rays are found below the umbel. In *E. esula*, many rays are regularly found below the more open terminal umbel, along the upper third of the stem. The hybrid also has many rays below the umbel but there is a greater tendency to a terminal concentration than in *E. esula*.

The three taxa can be separated by the following key which can be adapted to the key in Gray's Manual (Fernald, 1950, p. 964) and inserted between *E. cyparissias* and *E. lucida*.

Cauline leaves narrowly linear to linear-filiform or spatulate, 1-2 cm long 0.5-3 mm wide; floral leaves 4-6 mm long ..... *E. cyparissias*

Cauline leaves linear, broadly linear to oblong-lanceolate, longer and wider; larger floral leaves 1-2 cm long.

Median cauline leaves 1-10 mm wide; larger floral leaves 1-1.3 cm long; cyathia 2.5-3 mm high.

Cauline leaves to 7 cm long, 2-10 mm wide, not crowded ..... *E. esula*

Cauline leaves to 4 cm long, 1-5 mm wide, usually numerous and crowded ..... *E. × pseudo-esula*

Median cauline leaves 10-25 mm wide; larger floral leaves 1.2-2 cm long; cyathia 3-4 mm high ..... *E. lucida*

The hybrids resemble *E. esula* more closely than *E. cyparissias* and may be confused with Leafy Spurge. A plant that appears to be *E. esula* but has unusually numerous and small leaves may be suspected to be a hybrid. The intermediate chromosome number is conclusive evidence of hybridity. The hybrid nature of two of the three collections reported here has been verified by chromosome counts. Pollen of one hybrid plant was examined and found to be about 30% normal. Field observations indicate that a small amount of seed may be formed by hybrids.

Only hybrids between *E. esula* and tetraploid *E. cyparissias* have yet been found. Although diploid Cypress Spurge in Ontario lacks viable pollen, the pistil is normal and hybrids could probably be formed. The two cytological races seem to be morphologically indistinguishable. However, the presence in a hybrid of 10, rather than 20 chromosomes of *E. cyparissias* together with 30 chromosomes of *E. esula* may result in some differences in the appearance of the two cytological races of the hybrid.

Pritchard (1961) found that both diploid and tetraploid plants of *E. cyparissias* occur in Europe and that pollen-fertile diploid plants exist there. He found that tetraploids were more abundant and widespread but that both races occur in central Europe. Two forms of the hybrid have been recognized in Europe (see Moore, 1958). The form *polyphylla* Schur is said to be more

FIGURE 1. *Euphorbia* × *pseudo-esula* collected at Port Sydney, Muskoka (*Frankton 2085*).

like *E. cyparissias* whereas the form *pseudo-esula* is closer to *E. esula.* It may be that the two cytological races of *E. cyparissias* have crossed with *E. esula*, producing this variation. We have examined specimens of these forms from Dörfler's *Herbarium Normale* (*4295*, *4296*) and found them to be very similar, differing possibly in the width of the floral bracts which are slightly larger in *f. pseudo-esula.* In this character, our collections with the chromosome number $2n=50$ may fit better the form *pseudo-esula.*

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PRODUCTIVITY OF RICHARDSON'S GROUND SQUIRRELS NEAR ROCHESTER, ALBERTA[1]

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INTRODUCTION

SURPRISINGLY little is known about litter size in Richardson's ground squirrels *Spermophilus richardsonii* (Asdell 1964). This paper summarizes sex ratios, breeding dates, litter sizes, and intrauterine lossess in this ground squirrel in 1967 at Rochester, Alberta.

Rochester, located about 60 miles north of Edmonton, is near the northwest corner of the geographic range of Richardson's ground squirrel (Soper 1964). This species extended its range into the Rochester area as the land was settled and cleared, beginning in the 1910's.

MATERIALS AND METHODS

Samples of 6, 135, and 67 Richardson's ground squirrels were secured by shooting on 29 March, 18 April-11 May, and 1-15 July 1967, respectively.

[1]Contribution from the Rochester Wildlife Research Center, Rochester, Alberta, a research facility of the Department of Wildlife Ecology, University of Wisconsin, with cooperation from the Alberta departments of Agriculture (Veterinary Services Branch) and Lands and Forests (Fish and Wildlife Division), the Research Council of Alberta, and the Research Committee of the Graduate School, University of Wisconsin.

TABLE 1.—Sex ratios of Richardson's ground squirrels in 1967 at Rochester, Alberta. Squirrels were first seen above ground on 22 March.

Age and Sample Date	Number Males	Number Females	Males/100 Females
ADULTS			
29 March	6	0	–*
18–22 April	5	3	–
25–29 April	10	24	42*
1–5 May	16	44	36*
6–11 May	4	29	14*
1–15 July	4	7	57
Total	45	107	42*
JUVENILES			
1–15 July	27	29	93
FETUSES	26	28	93

*Ratio significantly different ($P < 0.02$) from 50:50.

Reproductive tracts were preserved in 10 percent formalin and subsequently examined for fetuses and implantation scars. The larger fetuses were sexed internally.

Fetuses were aged by measuring uterine swellings (length + width + height) as described for thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*) by Foster (1934). I plotted his data and modified the resulting curve for aging Richardson's ground squirrels by adjusting the scale on the swelling-size axis so that his value of 60 mm for term fetuses corresponded to my maximum value of 89 mm. These 8 largest fetuses were probably very close to term since they averaged 51 mm C-R length and 7.6 gm. Both of these values exceed those of 46 mm and 6.0 gm given for 42 postpartum Richardson's ground squirrels by Denniston (1957:415). Gestation period was taken as 28 days (Asdell 1964). Date of conception was established from estimated fetal age.

RESULTS AND DISCUSSION

Sex Ratios

Sex ratios of fetal and juvenile Richardson's ground squirrels were not significantly different from 50:50; however, among adults there was a shift from a predominance of males shortly after emergence in spring to an increasingly dominant percentage of females as the reproductive season progressed (Table 1). My sample of adults in July is small but suggests that females are in the majority at that time.

Other authors have noted adult sex ratios favoring females, especially in spring (Jacobsen 1923, Evans and Holdenried 1943, Fitch 1948, Sowls 1948, Tomich 1962, Zimny 1965, and McCarley 1966). Since males emerge from hibernation earlier than females (Foster 1934 and Sowls 1948), an excess of males in the sample early in the season might be expected. The predominance of females during the reproductive period could be due either to females being more numerous in the population or to behavioral differences which rendered them more vulnerable to shooting. I favor the first possibility since

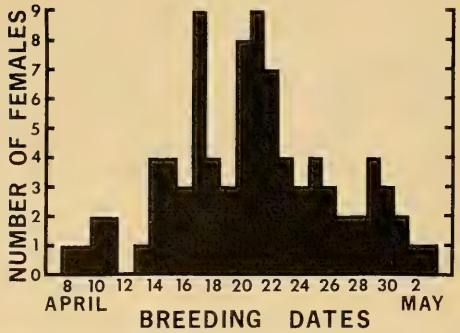

FIGURE 1. Calculated breeding dates for 87 Richardson's ground squirrels in 1967 at Rochester, Alberta.

males are less likely to survive to reproductive age than females (Fitch 1948:583 and McCarley 1966:307). Although there appears to be a progressive decrease in the proportion of males in my samples after 25 April (Table 1), this change is not statistically significant.

Breeding Season

Conception occurred from 8 April to 3 May, with the peak at 17-22 April (Fig. 1). Over three-fourths of the conceptions occurred in the two-week period of 14-27 April. Thus in 1967, breeding started about 2 weeks after and peaked about a month after the first squirrels were seen above ground on 22 March.

Productivity

All 69 adult females taken after breeding ceased (3 May) were or had been pregnant; nonbreeding is apparently rare in this species.

Eighty-four gravid females contained 735 live fetuses; an average of 8.75 fetuses per female (Table 2). However, average litter size decreased significantly from early to late pregnancy so that litter size at birth was probably about 8.0. This decrease occurred primarily during early pregnancy (Table 2). Litter size varied from 4 to 13.

Seton (1929) gives an average of 7.0 fetuses for 8 females, Howell (1938) gives 7.5 fetuses per female, and Fuller (1948) gives 9.3 fetuses per female but his sample contained only 3 females. Denniston (1957) gives an average of 7.0 young at birth for 6 litters.

A total of 42 fetuses (5.4 percent) were being resorbed; but resorption rate increased significantly as gestation advanced (Table 2). Number of resorbing fetuses per female varied from 0 to 3; and resorption occurred in 38 percent of the females. Tomich (1962) found that 9 of 150 fetuses (6.0 percent) were being resorbed and that 29 percent of 24 female *Spermophilus beecheyi* were involved.

Placental scar counts on 13 postpartum Richardson's ground squirrels yielded 9.85 scars per female (range 6 to 15). This value is not significantly higher than the mean litter size for all pregnant females but it is higher than that for females in the last third of gestation (Table 2). Tomich (1962) and

TABLE 2.—Productivity of Richardson's ground squirrels in 1967 at Rochester, Alberta.

Approximate Fetal Age (days)	Uterine Swelling Size (mm)	Number of			Percent of Fetuses Resorbing	Live Fetuses per Female
		Females	Live Fetuses	Resorbing Fetuses		
0–9	7–24	18	173	2	1.1[a]	9.61[c,d]
10–18	25–53	47	403	25	5.8[a]	8.57[c,e]
19–28	54–89	15	119	11	8.5[a,b]	7.93[d,e,f]
Not Taken		4	40	4	–	–
Total Gravid		84	735	42	5.4	8.75[g]
Postpartum		13	128	2	1.5[b]	9.85[f,g]

[a]Significantly different ($P < 0.02$) when tested in a 3×2 contingency table.
[b]Significantly different ($P < 0.02$) when tested in a 2×2 contingency table.
[c]Significantly different ($t = 2.06$, $P < 0.05$).
[d]Significantly different ($t = 3.04$, $P < 0.01$).
[e]Not significantly different ($t = 1.41$).
[f]Significantly different ($t = 2.53$, $P < 0.02$).
[g]Not significantly different ($t = 1.57$).

McKeever (1964) also found that scar counts gave higher average litter sizes than did fetal counts. These high counts are partly due to the difficulty of distinguishing scars of resorbed fetuses from scars of fetuses carried to term. Because of this difficulty in classifying placental scars, resorption rate based on scar counts (1.5 percent) was significantly lower than the 8.5 percent based on fetal counts during the last third of pregnancy (Table 2).

I did not calculate a juvenile:adult ratio for the July sample since I made a conscious effort to collect larger (adult) animals during this period.

ACKNOWLEDGMENTS

I wish to thank Lloyd B. Keith for critically reading this manuscript. I am also grateful to the landowners who allowed me to collect ground squirrels on their property.

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SOME NOMENCLATURE PROBLEMS IN NORTH AMERICAN *BETULA*

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In some recent taxonomic literature, for example the "Flora of the Prairie Provinces" (Boivin 1967), and "Flora of Alaska and Neighboring Territories" (Hultén 1968), changes in nomenclature in the genus *Betula* have been suggested. The purpose of this note is to comment upon some of these changes.

Several authors, including Fernald (1945) and Boivin (1967) have used the name *B. occidentalis* Hooker for the river birch. Boivin states that *B. occidentalis* is an acceptable name because it can be retypified, even though the types are mixed. However, as pointed out by Dugle (1964; 1966), *both* the description and the types refer to two different species, making *B. occidentalis* a *nomen confusum*. Thus *B. fontinalis* Sarg. (1901) is the correct name. Hultén (1968) has used "*Betula occidentalis* Hook.", with the quotation marks referring to his statement that these birches are hybrids between *B. glandulosa* and *B. neoalaskana* (*B. papyrifera* subsp. *humilis*). However, when the entire distribution of *B. fontinalis* is studied, it becomes evident that this birch is not a hybrid (Dugle 1964; 1966).

Boivin (1967) has described *B.* × *sandbergii* as being a "Hybrid of *B. papyrifera*", without reference to the other parental species, *B. glandulifera*. Referring to the Dugle annotations, he states "Most sheets so-named and examined were more characteristic of *B. occidentalis* [*B. fontinalis*] while a few rather resembled *B. papyrifera* or *B. nana* var. *glandulifera* [*B. glandulifera*]." However, birches of hybrid origin frequently resemble the parental species. Also, it is not surprising that *B.* × *sandbergii* superficially resembles *B. fontinalis*, which has some characteristics intermediate between shrub and tree birches.

It has been suggested by Boivin (1967) that specimens of *B.* × *winteri* (Dugle 1966) from "Craven, West Hawk Lake, etc." are outside the range of

one of the parental species, *B. neoalaskana*.[1] When more thorough collections are made in the provinces of Saskatchewan and Manitoba, Boivin's criticism can be better discussed. The locations of any specimens included by Boivin under "etc." is not known. However, it is biologically quite possible for the effects of introgressive hybridization to extend far beyond the distribution of one or the other of the parental species, as is the case in *B.* × *sargentii* which is found at much lower altitudes and far more southern latitudes than *B. glandulosa*, one of the parental species.

The resemblance of the types of *B.* × *eastwoodae* and *B.* × *uliginosa* in photographs is not sufficient reason to assume they are synonyms for *B. fontinalis* (= *B. occidentalis*). The distribution and hybrid nature of these birches as evidenced by both their difference in morphology and chromosome numbers has been thoroughly discussed (Dugle 1966).

I agree with Boivin's conclusion (Boivin, 1967) that the name *B. resinifera* Britton (Dugle 1966) was not correct. Since there has been considerable confusion in the nomenclature of this birch, a somewhat detailed discussion follows:

B. neoalaskana has 28 somatic chromisomes, and is distributed in north-central Canada and Alaska (Dugle 1966). Two of the previous names which have been applied are: *B. alba* subsp. *papyrifera* var. *humilis* Regel and *B. alba* subsp. *verrucosa* var. *resinifera* Regel [DC Prodr. 16, 2:166 (1868)]. The first, Regel's var. *humilis*, has been shown to be inappropriate by Boivin (1967). In addition, the epithet *humilis* is not available for a species same since it has already been used for a different species within the genus *Betula* (Article 64 of the International Code).

The second name, *B. alba* subsp. *verrucosa* var. *resinifera* Regel in Bull. Soc. Mosc. 18:398 (1865), was typified by a Middendorf collection from Siberia. Regel also used this name in DC Prodr. (1868) and added to the list of specimens a collection cited: "in America boreali-occidentali ad Saskatchavan (Palliser)." This collection (Bourgeau, 1858, on the Palliser expedition) was originally distributed as *B. papyracea* but was annotated by Regel and listed in DC Prodr. (1868) as indicated above [see Fernald (1945) for discussion]. Therefore, the Saskatchewan River collection cannot be included in the typification of the epithet *resinifera*.

The next major development in nomenclature of this species was its description of Sargent (1901) as *B. alaskana*. The type specimen for *B. alaskana* was the Bourgeau, 1858, specimen discussed above. This name was thought to be suitable until it was discovered that a fossil, *B. alascana*, had been named by Lesquereux in 1883. Consequently Sargent (1922) was forced to change the name to *B. neoalaskana*.

In 1901, one month following the publication of *B. alaskana*, Britton described a North American birch as *B. resinifera* (Regel) Britton. He listed *B. alba* subsp. *verrucosa* var. *resinifera* Regel, Bull. Soc. Mosc. 18:398 (1865)

[1]Boivin refers to the representative specimens as "syntypes" of *B.* × *winteri*. Since a holotype was designated, the representative specimens are by definition paratypes, not syntypes.

as a synonym. A complete description of the birch was followed by a statement that a specimen collected by R. S. Williams, 13 August 1899, was the type of his species. In addition Britton listed three other specimens from North America immediately following his citation of type.[2] His comment: "Our material agrees in every respect with Regel's description in DeCandolle's Prodromus 16: Part 2, 164. 1868." is significant. Britton appears to have used the above description to compare the two entities. However, Note 5 under Article 7 states: "A new name formed from a previously published legitimate name or epithet (stat. nov., comb. nov.) is, in all circumstances, typified by the type of its basionym." Therefore, one must attempt to determine the intention of Britton when he published his name, *B. resinifera*. By naming types, he indicated he was substituting a new name, but his method of writing, his description and his synonymy imply he was making a new combination. Elimination of the synonymy of *B. resinifera* (Dugle 1966) is one solution to the quandry, but it may be contrary to Note 5 under Article 7 of the Code. It should be pointed out that this interpretation of the Code is only one of several and that the addition of Note 5 which was passed at the Edinburgh Congress has changed interpretations considerably. Amendments or additions to Article 63 being considered by committee may affect the above discussion and the following conclusion. As Boivin suggested, *B. resinifera* Britton (1901) is incorrect and *B. neoalaskana* Sargent (1922) is the oldest legitimate name available.

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[2]The Williams specimen (NY) has been lost, but the second specimen listed (US) has been located and annotated as "Paratype" for *B. resinifera* Britton (Dugle 1966).

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RANGE EXTENSIONS FOR SOME ALASKAN AQUATIC PLANTS

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OUR knowledge concerning the distribution of the Alaskan aquatic flora remains inadequate, despite such recent floristic works as the *Flora of the Aleutian Islands* (2nd edition) by Hultén (1960), *A Flora of the Alaskan Arctic Slope* by Wiggins and Thomas (1962), and in particular the *Flora of Alaska and Neighboring Territories* by Hultén (1968) with its well-done distribution maps for each taxon. The present paper, which represents a report of some of the more significant aquatic plant records deposited in the University of Alaska Herbarium, is an attempt to amplify the available distributional information.

While involved with an aquatic plant study[1] in the middle Tanana River valley, interior Alaska, I had the opportunity of making field observations and fairly extensive collections of the aquatic vascular plants in lakes and ponds of this region. Also between 1964 and 1968, I was privileged to make field expeditions to many other parts of Alaska, supported in greatest part by the University of Alaska Museum, but with frequent cooperation from the U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Coast Guard Service, U.S. Navy, etc., during which many aquatic as well as other plant collections were made. As curator of the University of Alaska Herbarium for five years, I was involved in the processing of nearly 16,000 specimens, including numerous aquatic plants. With the initiation of my aquatic plant studies in 1965, I attempted to correctly redetermine and compile the aquatic plant records which were represented in the University of Alaska Herbarium. When these locality records were mapped, some were found to significantly extend the reported ranges of certain aquatic species, and others helped to narrow or bridge apparent distributional gaps between previous records. Although it is often difficult to judge the relative phytogeographic significance of such distributional records, the following citations appear worth noting. In this paper, which represents a compilation of aquatic plant collections by many persons whose material has been deposited in the University of Alaska Herbarium (ALA), acknowledgements are accorded to the respective collectors in the specimen citations below.

1. BIDENS CERNUA L. Tanana River Valley: Nenana, *H. Schmuck 7-63*; Harding Lake, ca. 50 mi. s.e. of Fairbanks, *B. R. Knobloch 112-66*; Lost Lake, ca. 65 mi. s.e. of Fairbanks, *B. R. Knobloch 66-66*; Tetlin Lake, *K. Schneider 76*. The known Alaskan range of this possibly introduced bur-marigold species is extended about 200 miles to the southeast, but still leaves the Alaskan distribution nearly 850 miles disjunct from that of the rest of North America.

2. CERATOPHYLLUM DEMERSUM L. Upper Tanana River Valley: Northway area, *D. Rose 77*. This species was first reported for

[1]Supported by 1965-1966 grants from the Office of Water Resources Research, United States Department of Interior, to the University of Alaska Institute of Water Resources.

Alaska by Smith (1956) from near Summit, 10 miles east of Cantwell, in the Alaska Range, and recently Hultén (1968) indicated its occurrence at Fort Yukon. Thus, the Rose collection from Northway apparently represents only the third record for the species in Alaska. These widely separated Alaskan localities are all at least 800 miles west or northwest of the nearest North American stations for the species at Great Slave Lake in southern Mackenzie District, at Wood Buffalo National Park in northern Alberta, and in southern British Columbia. The species might well be expected elsewhere in Alaska and northwestern Canada. However, since its occurrence seems similarly sporadic in northeastern Asia, the species on both sides of the Bering Sea may now be limited to a few surviving outposts after a general withdrawal from the Beringian area which probably represented at least one of its major centers of post-Pleistocene dispersal.

3. CICUTA DOUGLASII (DC.) Coult. & Rose. Central Yukon River Valley: Fort Yukon, *G. W. Gasser*. This record extends the known range of this water-hemlock about 70 miles north of the former Circle Hot Springs report (Hultén, 1947), and represents only the third interior Alaskan station (and the first not from a hot springs site) for this rather infrequently recorded species otherwise found in Alaska only along the Pacific Coast.

4. ELEOCHARIS ACICULARIS (L.) Roem. & Schult. Central Yukon River Valley: Huslia, lower Koyukuk River area, *S. Harbo 20*; Small Lake, between Sheenjek and Coleen Rivers (67° 23′ N., 143° 50′ W.), *S. Shetler 628-AF*. Although these records do not extend the species' perimeters in Alaska, they help to bridge several prominent gaps in the known distribution, documenting the species' presence in the central Yukon River valley between the west coast and interior stations, and between the latter and reports from the lower Mackenzie River, N.W.T.

5. ELEOCHARIS PALUSTRIS (L.) Roem. & Schult. (including *E. macrostachya* Britt., but not *E. uniglumis* nor *E. kamtschatica*), Central Pacific Coast Region: Skilak Lake, Kenai Pa., *C. Divinyi 22 July 1958*. Upper Alaskan Peninsula: Naknek Lake, Katmai Natl. Mon., *D. T. Hoopes 11 July 1961*; Iguigig, head of Kvichak River, outlet of Iliamna Lake, *Harms 4370*. Tanana River Valley: Minto Lakes, *N. Hosley*; George Lake, ca. 30 mi. s.e. of Delta Junction, *Harms 3420*; Northway area, *D. Rose 7, 11*. Central Yukon River Valley: Huslia, Lower Koyukuk River area, *S. Harbo 17*; Fishhook Creek, Black River area, *S. Shetler 437-AF, 438-AF*; Small Lake, between Sheenjek and Coleen Rivers, *S. Shetler 857-AF*. The Huslia record extends the species' known range about 200 miles west and north of the former reports from the Wiseman, Fairbanks, and McGrath areas. The northeastern Alaskan records from Small Lake and the Black River areas narrow somewhat the apparent gap between the known Alaskan distribution and reported stations from the Mackenzie River delta, N.W.T. The other collections merely serve to better fill in the distribution of this spikerush in Alaska.

6. LYSIMACHIA THYRSIFLORA L. Alaska Range Area: Talkeetna Mts., *C. Yamada 6-61*; Yanert Fork of Nenana River, *F. C. Dean 15 Aug. 1959*. Tanana River Valley: Midway Lake, 12 mi. s.e. of Tetlin Junction, *D. Rose 44*. These Alaskan Range and Tanana valley records help to bridge the wide distributional gaps between the few former interior Alaskan and the scattered coastal reports for this infrequently collected species in Alaska.

7. MYRIOPHYLLUM SPICATUM L. ssp. EXALBESCENS (Fern.) Hult. Central Pacific Coast: Jim Lake, Upper Knik arm, near Palmer, *R. E. LeResche 22*. Upper Alaskan Peninsula: Nystrom Lake, Katmai Natl. Monument, *D. T. Hoopes 11 July 1961*. Tanana River Valley: 20 mi. s. of Clear near Nenana River, *Harms 5055*; Harding Lake, ca. 50 mi. s.e. of Fairbanks, *Harms 5757, G. Smith 2281, B. R. Knobloch 84-66*; Lost Lake, ca. 65 mi. s.e. of Fairbanks, *B. R. Knobloch 42-66, 60-66*. South Slope Brooks Range: Last Lake, Upper Sheenjek River, 20 mi. above Old Woman Creek, (68° 35′ N; 143° 50′ W), *B. Kessel S-188*. The Palmer and Katmai National Mounment records extend the known range of this sub-species to the central Pacific coast region over 250 miles south of the previous lower Yukon River and Alaskan Range sites. While subspecies *exalbescens* seems replaced elsewhere along the Pacific Coast (i.e., in southeastern Alaska and western Aleutians) by subspecies *spicatum*, the above cited Palmer and Katmai records for subspecies *exalbescens* are not overly surprising since they are disjunct from the previous and occur within the narrow Pacific coastal extension of the interior *Picea glauca-Betula papyrifera* forest.

8. NUPHAR POLYSEPALUM Engelm. Alaska Peninsula: Ugashik area, *D. Streubel 27 July 1967*. Alaska Range: McGonnigal Pass, Mt. McKinley Natl. Park, *A. & R. Nelson 4286*. Tanana River Valley: Lost Lake, ca. 65 mi. s.e. of Fairbanks, *B. R. Knobloch 61-66*; George Lake, ca. 30 mi. s.e. of Delta Junction, *Harms 3211*; Upper Berry Creek, *L. A. Spetzman 1022*. Central Yukon River Valley; 30 mi. above Circle, *K. Alt 52*. Although not expanding the overall known range of this species in Alaska, these records serve to better fill in its central Alaskan distribution and the collection from Ugashik narrows the wide gap between the former reports (Hultén, 1944) from Katmai and Unimak Island.

9. NYMPHAEA TETRAGONA Georgi. Tanana River Valley: Harding Lake, *B. R. Knobloch 43-66, 45-66*; Northway, *D. Rose 92*. Central Yukon River Valley: 40 miles above Circle, *K. Alt 54*. These records supplement the known Tanana Valley disrtibution of this sporadically distributed water lily and also extend the species' known Alaskan and North American range northward to the central Yukon River 40 miles above Circle.

10. POTAMOGETON FRIESII Rupr. Tanana River Valley: College, *G. W. Argus 1097*; Lake Killarney, 3 mi. w. of College, *G. W. Argus 516*; Blair Lake, ca. 45 mi. s.-s.e. of Fairbanks, *G. Smith 1903*; George Lake, ca. 30 mi. s.e. of Delta Junction, *Harms 3120, 3212*; Northway, *D. Rose 5*. These records help to fill in the Tanana River Valley distribution of this infrequently collected pondweed species in Alaska, and the Northway collection narrows the distributional gap separating the scattered Alaskan records and those from southern Yukon Territory.

11. POTAMOGETON NATANS L. Tanana River Valley: Nenana area, H. Schmuck *July 1963*; Northway, *D. Rose*. These collections add two more stations for this rarely collected species in Alaska and help to connect the eastern and more western interior Alaskan records.

12. POTAMOGETON PRAELONGUS Wulf. Alaska Range: Tok Hwy., 29 mi. n.e. of Gulkana, *G. Smith 2302*. Tanana River Valley: Harding Lake, ca. 50 mi. s.e. of Fairbanks, *B. R. Knobloch 81-66, G. Smith 2283A*; Richardson Hwy., 60 mi. s.e. of Fairbanks, *G. Smith 2273A*; Northway area, *D. Rose 60*. Small Lake, between Sheenjek and Coleen Rivers, *S. Shetler 677-AF, 843-AF*. Bering Sea: Big Lake, St. Matthew Is., *Harms 5584*. The Tok Highway and Northway collections help to bridge the distributional gaps between former records from central Alaska, south central Alaska, and Kluane Lake, Yukon Territory. The collection from Saint Matthew Island represents nearly a 600 mile Alaskan range extension north of the previous central Aleutian sites at Atka and Adak, over a 500 mile extension northwest of the previous Katmai site, upper Alaskan Peninsula, and nearly as far southwest of the previous Teller site, Seward Peninsula. However, the rather remote Saint Matthew Island station is probably less surprising than first appearances might suggest, since *P. praelongus* is a circumpolar species found also in eastern Siberia and it probably has survived the Pleistocene epoch in the Beringian refugium.

13. SAGITTARIA CUNEATA Sheldon. Tanana River Valley: Minto Lakes, *N. Hosley 7-50, Harms 5781*; George Lake, about 30 mi. s.e. of Delta Junction, *Harms 3171*;Northway area, *D. Rose 90*. Central Yukon River Valley: Fort Yukon, *G. W. Gasser 3 Aug. 1934*; Fishhook Creek, Black River area, *S. Shetler 558-AF, 504-AF*. These records supplement considerably the three previous reports for this arrowhead species in Alaska. The latter two collections apparently represent the most northern reports for this North American species. In Alaska, *S. cuneata* appears limited to the Pleistocene-unglaciated middle Yukon and Tanana River valleys. At George Lake, the species was surprisingly abundant on silty and sandy bottoms, producing flowering scapes in shallow water of less than a half meter depth, but forming only basal rosettes at greater depths.

14. SCUTELLARIA GALERICULATA L. (*S. epilobiifolia* A. Ham.) Central Pacific Coast: Moose River below Sterling, Kenai Pa., *L. Bidlake*. Tanana River Valley: Northway area, *D. Rose 16, 88*. The Kenai Peninsula collection extends the known Alaskan range of this skullcap species about 60 miles south of previous reports from Anchorage and the Matanuska valley, and the Northway record narrows the gap between the Alaskan collections and the one from Mayo, Yukon Territory.

15. SIUM SUAVE Walter. Tanana River Valley: Fish Lake, 25 mi. e. of Tanana, *G. Smith 1778* (distributed as *Cicuta mackenzieana*); Big Minto Lake, *L. Rowinski 20*

July 1956. This rare species has been previously reported in Alaska from only three widely spaced localities along the Yukon River: Holy Cross, Galena, and the Black River area. The present records indicate its presence as well along the lower Tanana River drainages. The infrequent collecting of this water-parsnip species in Alaska may be due partly to its general similarity to the common water-hemlock species, *Cicuta mackenzieana* Raup. The nearest non-Alaskan collections appear to be those from the upper Liard River near the Yukon-British Columbia border and the Great Slave Lake area of southern Mackenzie District, N.W.T.

16. SUBULARIA AQUATICA L. Tanana River Valley: Harding Lake, ca. 50 mi. s.e. of Fairbanks, *Harms & Knobloch 5755*; George Lake, ca. 30 mi. s.e. of Delta Junction, *Harms 3173*; Moon Lake, 10 mi. w. of Tanacross, *Harms 6292*. While the present records scarcely alter the overall Alaskan distribution of this rarely collected species, they represent a few additional collection sites, and suggest the species' common occurrence in the Tanana River valley of the interior despite most previous records having been from the Alaska Range or the Pacific and Bering Sea coastal regions. At each of the Tanana valley lake sites listed above, the plants were locally abundant on firm, sandy, shallow bottoms in wave-protected coves.

17. TRIGLOCHIN PALUSTRIS L. Southeastern Pacific Coast: Yakutat, *Harms 3208*. Central Yukon River: Circle Hot Springs, *G. Smith 2639-A*. South Slope Brooks Range: Onion Portage on Kobuk River, *C. Schweger 85*; Walker Lake, *G. Smith 2466*; Old Woman Creek, upper Sheenjek River, *B. Kessel S-64*. The collections from the south slope of the Brooks Range tend to bridge the formerly evident gap in this species' distribution between the Bering Strait records and those farther east from interior and southern Alaska.

18. TYPHA LATIFOLIA L. Tanana River Valley: Mile 10 Chena Hot Springs Road, ca. 15 mi. n.e. of Fairbanks, *D. E. Seim 27 July 1965*; Ester City, ca. 12 mi. w. of Fairbanks, *D. Roseneau 35*. Yukon River Valley: 12 mi. s.w. of Circle, *M. E. Hatler 56*; Fort Yukon, *Harms 3757-B*; Fishhook Creek, Black River area, *S. Shetler 587-AF*; Small Lake, between Sheenjek and Coleen Rivers, *S. Shetler 845-AF*. These collections fill in better the known Alaskan distribution of this cattail, especially in the central Yukon River valley, and extends it over 100 miles to the northeast. The Small Lake collection apparently represents the most northern record for the species in either North America or Eurasia. Except for one south-central Alaskan collection from the Lower Susitna River, cattails in Alaska appear restricted to the Pleistocene-unglaciated, middle Yukon and Tanana River valleys. Although highly sporadic in their Alaskan occurrence, cattails frequently represent the dominant emergent plants in those ponds where they are present.

19. ZOSTERA MARINA L. Uppper Alaska Peninsula: Kukak Bay, Katmai Natl. Monument, *C. L. Estabrook 201*. Bering Sea Region: Mekoruk River mouth, Nunivak Is., *J. G. King 67*; Cape Newenham, Nanak Bay, *J. L. Hout 69*. The records from along the Bering Sea coast narrow somewhat the distributional gap between the former Pacific Coast and the Bering Strait reports for eelgrass. This marine species should probably be expected in shallow surf-protected coves all along the Bering Sea coast as it is along the Pacific coast, although it may truly be absent along the Arctic coast.

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RECENT DATA ON SUMMER BIRDS OF THE UPPER YUKON RIVER, ALASKA, AND ADJACENT PART OF THE YUKON TERRITORY, CANADA

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FROM 10 June through 3 August 1966, we surveyed the Peregrine Falcon (*Falco peregrinus*) population along the upper Yukon River to gather data on peticide residues in this population. Some of the results of the Peregrine study have been published (Cade, White, and Haugh, 1968). During our study several points regarding the general avifauna of the region became evident, as follows. Although considerable biological work has been done along the Yukon, such as that done by various University of Alaska summer field parties, and much is known about the river, little recent published information on birds is available in the literature for use as background material for further studies. Furthermore, judging from the literature available and from our recent observations, it is evident that some bird populations are apparently historically stable, that is, they show the same relative numbers today as they did in earlier investigations (i.e. Dall and Bannister, 1869; Bishop, 1900; Osgood, 1909; Blackwelder, 1919; Cade, (field notes 1951); and Gabrielson and Lincoln, 1959). Other populations show marked fluctuations in numbers, that is, they are abundant in some years, absent in others, or show vacillating trends in population numbers. Still other populations or species are newly invading the region and/or are becoming established as breeders. Additionally, during our work, several observations of lesser known species were made. This report presents information on some of the above mentioned points in addition to giving an annotated list of our observations and data on species not previously recorded for interior Alaska.

Through the courtesy of Tom J. Cade we were allowed use of his field notes taken on the Yukon from 11 July to 25 August 1951. We also traveled with Tom Cade, James Enderson, and Stanley Temple and made further observations on the Yukon from 30 May to 11 June and from 16 to 20 July 1968, with the principal purpose of obtaining additional data on peregrines. This report is composed of data extracted from field notes for 117 days of observations on a precise stretch of river.

The term "Upper Yukon", as used in this report, is that portion of the river extending from Circle, Alaska, to the mouth of the Fortymile River, Y.T., Canada, a distance of approximately 200 river miles. The upper Yukon follows a valley course through mountainous terrain, usually cutting cliffs where it flows close to steep-sided mountains and/or bisects these mountains. Where the river does not closely approach the mountains, there are frequent spruce covered flats and areas of muskeg extending inland from the river a few miles until the floodplain, in turn, abutts the base of the mountains.

Several moderately large rivers join the Yukon at various points, namely, the Seventymile, Tatonduk (Sheep Creek of some reports), Nation, Kandik (Charley Creek of some reports) and Charley River. For several miles around the mouth of the Charley River the terrain is broad, flat, and devoid of relief. One section of high, rugged cliffs terminating at the river's edge, sometimes referred to as the Woodchopper Volcanics, is nearly 4 miles in length and rises 1500 feet above the level of the river. At Circle the terrain has essentially lost it's relief and the river traverses the Yukon Flats, a region characterized by numerous lakes, acid muskeg bogs, erratically meandering sloughs and rivers, and spruce, willow, and cottonwood covered flats. Although this report is essentially confined to that region upriver from Circle, we did on one occasion travel about 12 miles downriver from Circle and some observations from this area are noted in the report.

Those species known to have bred or suspected of breeding during our survey (as evidenced by the physiological state of adult, such as the presence of a brood patch; behavioral actions of the adult, such as food gathering, etc.; or the presence of birds of the year) are marked by an asterisk in the following annotated list.

ANNOTATED SPECIES ACCOUNT

Gavia immer — COMMON LOON. Several were seen, or heard calling in 1966 as follows: 12 June, near Kathul Mt.; 1 July, mouth of Nation River; 3 July, mouth of Kandik River (several); and 9 July, heard calling at Circle.

Gavia arctica — ARCTIC LOON. Less frequently seen than *Gavia immer*. On 19 June 1966, one was seen and heard calling at Eagle and on 23 June two were seen near the Nation River. The few records may reflect the lack of our observations of inland ponds, rather than actual numerical status.

Gavia stellata — RED-THROATED LOON. We did not observe it in 1966, but saw one bird that may have been this species in 1968. Cade saw it on two occasions in 1951.

Podiceps grisegena — RED-NECKED GREBE. Our only record is the remains of one found in a peregrine falcon aerie in 1966. Cade recorded one in 1951.

Podiceps auritas — HORNED GREBE.* Our only records for 1966 are the remains of three individuals found in a peregrine aerie and a mummified downy young found in Beck's cabin near the Kandik River. Cade recorded at least two in 1951. They are doubtless common in sloughs adjacent to the river.

Olor sp. — WHISTLING OR TRUMPTER SWAN. On 14 June 1966, a fully adult swan was seen taking off from the river in front of the village of Eagle.

Branta canadensis — CANADA GOOSE.* Although Canada Geese place their nests on cliffs and bluffs and are associated with bluffs in many parts of Alaska, e.g., the Colville River, this is not the case on the Yukon River as suggested by Kessel *et al.* (1966). On the Yukon, the geese use or nest on pond edges, islands and river banks. Observations on the river are scattered but not uncommon. A few observations on the occurrence of this goose are noted below. On 10 July 1966, about 10 separate pairs were seen in a 10-mile stretch of river downriver from Circle and also a flock of 15 were seen near Circle. On 13 June, a pair with seven young less than a week in age was seen a few miles downriver from Montauk Mt. On the Nation River on 1 July 1966, we saw a pair with 6 young which had the black tips of the primary feathers unsheathed for about 2 inches. Cade saw a flock of about 60 on 23 August 1951, about 20 miles upriver from Circle and on 24 August, two flocks, one of about 25 and one of about 35, were seen at Circle.

Branta nigricans — BLACK BRANT. Two were seen on the river upriver from Eagle on 15 June 1966. Niel Argy, U.S.F.W.S., Fairbanks, informed us that accumulating records indicate that they occur regularly along the

Yukon but apparently there is no trend for increasing numbers. (See Cade (1955) for previous records and discussion of inland migration routes.

Anser albifrons — WHITE-FRONTED GOOSE. Not seen in 1966 when observations started on 10 June; but in 1968, between 31 May and 8 June, they were moderately common. None was seen by Cade in 1951.

Anas platyrhynchos — MALLARD.* Seen regularly along the entire river but not common in 1966. Cade saw a flock of 37 and a flock of 35 on 14 August 1951, near the Kandik River.

Anas acuta — PINTAIL.* Observed regularly along the river. Small flocks of males, usually between 7 and 15 per flock, were seen during the last two weeks of June, 1966. In contrast to the mallard, they were common enough to be taken frequently as prey by Peregrine Falcons in 1951 and 1966. Interestingly, Osgood (1909) records the Mallard as fairly common on the river and the Pintail as uncommon.

Anas strepera — GADWALL To add to the growing list of observations (see Kessel and Springer, 1966) one was seen on the river 17 July 1968, in the vicinity of the Woodchopper Volcanics.

Anas carolinensis — GREEN-WINGED TEAL.* Although this species was recorded as scarce in the interior in the early 1900's and none was seen along the river by Osgood (1909) and only three were seen by Bishop (1900) at Circle, we noted the species at several localities in 1966. The species also was counted 7 times as prey items in peregrine aeries in 1951, 9 times in 1966 and 5 times in 1968.

Anas discors — BLUE-WINGED TEAL. Kessel and Springer (1966) note the increasing abundance of this species in the Yukon River region. None was recorded by Bishop (1900) nor Osgood (1909) although it was found "sparingly" at Fort Yukon in 1865-66 by Dall and Bannister (1869). In 1966, only 3 adults were seen near the U.S.-Canada boundary on 21 July. By contrast there were a dozen or so observations scattered along the river between the Fortymile River and Circle during the first week of June, 1968.

Spatula clypeata — SHOVELER.* We observed Shovelers on three occasions all in the general region of Eagle in 1966. On 20 July, a group of three males molting into the eclipse plumage was seen.

Mareca americana — AMERICAN WIDGEON.* On 12 June a flock of about 15 was seen near Charley River, and a flock of 15-25 was seen on 28 June, 1968 near Eagle. Additionally, we observed single birds or pairs along the entire stretch of river at various dates.

Aythya collaris — RING-NECKED DUCK.* This species may also be increasing in interior Alaska (Kessel and Springer, 1966). A female with a brood of at least three one-fourth grown young, was seen in a slough of the river on 28 July 1966, downriver from Takoma Bluff. The female floppped around the slough for several minutes as we approached and then as we proceeded to follow her closely, she slowly swam down the river. During her initial performance the young promptly hid making it difficult to obtain an accurate count of them. This record adds to the few breeding records mentioned by Kessel and Springer (1966).

Aythya marila — GREATER SCAUP.* Individuals were seen at scattered localities with a flock of about 10 mixed males and females observed on 28 June 1966 near the Tatonduk River.

Aythya spp.* — Several individuals, either Greater Scaup *A. marila* or Lesser Scalp *A. affinis,* were seen at scattered localities. One bird seen on 17 July, with a flock of scaup, had a conspicuous red-colored head but conditions were too dark and overcast and the bird was seen too briefly to preclude positive identification, although it might have been a Redhead (*A. americana*). Scaup were fairly common

Bucephala albeola — BUFFLEHEAD. A male and two females flew past the boat on 12 June 1966, near the mouth of the Charley River.

Bucephala spp. — GOLDENEYES.* We had scattered observations in 1966 along the river. The majority of individuals were thought to be Common Goldeneye *B. clangula* rather thas Barrow's Goldeneye *B. islandica.* One female, in a slough of the river, acted as though she had a brood of chicks nearby on 5 July near the Woodchopper Volcanics, and a second female was seen with a brood of at least 6 young near Circle on 10 July 1966.

Clangula hyemalis — OLDSQUAW A lone female, with a flock of seven Surf Scoters, was seen near the mouth of the Seventymile River on 28 June 1966.

Histrionicus histrionicus — HARLEQUIN DUCK. Cade found the remains of one in a peregrine aerie on the Yukon in 1951. It has been recorded on tributaries of the Yukon, that lie between Eagle and Circle, and possibly it occurs on the Yukon proper. We did not see it in 1966 nor in 1968.

Melanitta deglandi — WHITE-WINGED SCOTER. Decidedly less common than Surf Scoters. Only three, a male and two females, were seen together on the river near the mouth of the Kandik River on 17 July 1966.

Melanitta perspicillata — SURF SCOTER.* A fairly common species on the river. Pairs were occasionally seen but mixed flocks of males and females and large flocks composed entirely of males were more commonly observed. On 6 July 1966, a flock of 86 males was seen as it made two passes over Circle. On 18 July 1968, a flock of 12-15, all but one being males was seen below Takoma Bluff. Cade saw a flock of 40-50 on 30 July, and a flock of 43, all juvenile birds, on 14 August 1951. Osgood (1909) also noted flocks composed largely of males. Bishop (1900) lists it as abundant unriver from Circle.

Mergus spp. — MERGANSERS. All mergansers seen were probably Red-breasted Merganser *M. serrator* but positive identification was not made on all individuals. Our only record for 1966 was a pair seen briefly as they flew up the Tatonduk River from near its mouth. Blackwelder (1919) cites the species as common on the Yukon. Several were seen near the mouth of the Nation River in 1968. Cade observed it on two occasions in 1951.

Accipiter gentilis — GOSHAWK. Not seen by us in 1966 and 1968, but one immature was seen by Cade on 4 August 1951. The paucity of observations during the breeding season is somewhat surprising considering the habitat of the region.

Accipiter striatus — SHARP-SHINNED HAWK.* We saw this hawk on four occasions in 1966. On 16 June one was seen near Eagle Creek. It remained in the area for a length of time, apparently hunting, and it may have nested nearby. On 18 August 1951, Cade saw an immature perched beside a merlin on a fish rack.

Buteo jamaicensis and "*harlani*" — RED-TAILED HAWK.* Two pairs with nests and one lone adult were seen in 1966. The members of both pairs had the mottled "*harlani*" tails. In 1968 some eight individuals were seen, two of which had brick-red tails. No nesting activities were observed in 1968. The Indians at Eagle make a definite connection between rabbit population cycles and hawk cycles for they told us (1966) that the rabbit cycle was down and we probably would not see any hawks. The relationship between rabbit cycles is seemingly born out by observations in 1951 when prey species were more abundant and Cade noted *Buteos* on eight occasions and on at least two occasions several were seen. Cade recorded four nests between the Fortymile and Circle. Further, we saw no owls in 1966 and 1968, and Cade noted several (see under *Bubo*). Of the hawks seen in 1951, only one had a "red-tail". On 14 July 1966, a nest about 10 miles above Circle contained two downy young. The nest was on an island in a 60 foot cottonwood (*Populus balsamifera*) about 10 feet from the top. One young weighed 653 grams. It was completely covered with a sooty-gray down except for the primary feathers which were about 45 mm out of the sheaths and tail feathers which were about 30 mm out of the sheaths. Inasmuch as the downy young and early nesting plumages are not well described (Friedmann 1950) it may be of interest to note that each young possessed a perfect, well-defined "triangle" of pure white down on the back of the head measuring about 34 mm at the base and 45 mm from base to apex. In other *Buteos* the white spot on the back of the head has been defined as an irregular circle. When fully feathered the young were generally blackish with some white mottling on the venter.

A total of 15 maggots, the largest measuring 10 mm long, was taken from the ears of one of the young. They were identified as *Protocalliphora* spp. by Kenneth J. Capelle, Bear River Wildlife Refuge entomologist. Food remains in the nest consisted of a red squirrel (*Tamisciurus hudsonicus*), several microtines, Bohemian Waxwing (*Bombycilla garrula*), an unidentified anatid, Gray Jay (*Perisoreus canadensis*) and Common Snipe (*Capella gallinago*). The two young found in one nest on 19 July 1951, were well feathered on their lower breasts and backs. Food remains in 1951 consisted of *Microtus* spp., two Spruce Grouse (*Canachites canadensis*), and some unidentified passerines.

Frank Warren of Circle told us that in 1965, three of these hawks were on Birch Creek near the bridge near Circle. One was shot as it was in the process of killing a

Canada Goose (*Branta canadensis*) gosling near the edge of the creek. This hawk was black and had a mottled tail

Aquila chrysaetos — GOLDEN EAGLE. In 1966, none was seen on the river but one was seen on the Taylor Highway about midway between Eagle and Tok as it hovered in the air much after the fashion of a *Buteo*. In 1968, however, five single birds were seen. In addition, two individuals were seen perching together in a tree midway between Eagle and Calico Bluff. The latter sighting may have involved a mated pair. On 23 August 1951, Cade saw a brown-headed eagle, either this species or an immature Bald Eagle (*Haliaeetus leucocephalus*), being attacked by a raptor, possibly a Peregrine Falcon.

Haliaeetus leucocephalus — BALD EAGLE. Two Bald Eagles, one adult and one immature, were seen on 8 June 1968, below Kathul Mt. None was seen in 1966 although we were told that a pair had long nested about two miles up the Charley River from its mouth. Because of low water conditions, we were unable to investigate this report. This nest, however, might have been that of an Osprey (*Pandion haliaëtus*) as that species has reportedly bred on the Kandik River (Williams, 1925).

Circus cyaneus — MARSH HAWK. In 1966, some six observations were made between 13 June and 30 July from Circle to about 10 miles above Eagle. In contrast, none was seen in 1968. Cade saw them on five occasions between Eagle and Circle in 1951. (Bishop (1900) mentions a few. It appears to be of sporadic occurrence and may be more common downriver from Circle on the Flats (see Blackwelder, 1919).

Falco peregrinus — PEREGRINE FALCON.* Data on this species have been summarized (Cade, *et al.*, 1968). A few items are of interest. Bishop (1900) reported that it was distributed along the river from Fort Davidson to Circle at an interval of about one pair per 10 miles. Cade found the average distance between pairs in 1951 to be 9.3 miles while in 1966, for 172 miles there were 17 pairs for an average distance of 10.5 miles. In 1968, along the same 172 mile stretch there were also pairs or single birds at 17 breeding stations or individual cliffs. These data would indicate a rather strict historical stability in the numbers of pairs along the river. Charlie Stevens, a chief at one time in the Indian village at Eagle, told us that the Indian name for the Peregrine is Khé-trund (our phonetics) which literally means shoulder. This name arises from the fact that they believe that Peregrines strike their prey with the shoulder of the wing (actually wrist) as it is bent back in the Peregrine's stoop. Willie Junabee, also of Eagle Village, told of an occasion when the natives watched a Peregrine in front of the village stoop repeatedly at a crane until the latter was forced into the river. The Indians were of the impression that the Peregrine directed its stoops at the head of the crane. Another observation of interest is that of Circle resident Carl Dasch who while goose hunting in late August in front of his cabin watched a Peregrine stoop at and hit a wooden goose decoy with such force that it knocked the head off of the decoy and momentarily dazed the falcon.

Falco columbarius — MERLIN. We failed to to see this bird in 1966. In 1968, one and possibly a second was seen the first week in June. Cade recorded it on nine occasions in 1951. His earliest record was on 19 July, but all other records were in August. Two or three were frequently seen together and appeared to be sibling groups.

Falco sparverius — AMERICAN KESTREL.* Single individuals were seen on four occasions in 1966 between 21 June and 17 July and nine times in June, 1968. Only two were females. Some of the birds were associated with cliffs and may have used them for nesting. Bishop (1900) saw this species only as far up the river as Fort Selkirk with one possible sighting at Circle. Osgood (1909) does not mention it and none was seen by Cade in 1951 on the Yukon River. Cade (pers. comm.) recalls seeing only the rare individual throughout most of Alaska in the early 1950's and White observed only two pairs in the Fairbanks area in 1962 and 1963. The species may be generally increasing its range throughout Alaska as noted by Campbell (1968).

Canachites canadensis — SPRUCE GROUSE. The remains of an individual found near a Peregrine aerie is our only record for 1966. Cade saw them, usually immature birds, on several occasions in 1951.

Bonasa umbellus — RUFFED GROUSE.* Our only record is of a female with at least four ¾ grown young 21 miles upriver from Circle on 28 July 1966. On 24 July 1951, Cade

saw a female with nine "well grown" young, in the Yukon Territory. This was his only record for this bird.

Grus canadensis — SANDHILL CRANE. On several occasions we heard and saw cranes near Circle in July and August, 1966, and also the first week of June, 1968.

Pluvialus dominica — GOLDEN PLOVER. A flock of nine birds, believed to be this species, was seen on 14 August 1951, by Cade near the Kandik River.

Capella gallinago — COMMON SNIPE.* Common and widespread in 1966 and 1968. Interestingly, winnowing had ceased by 5 July and no winnowing birds were heard until 17 July 1966, at which time they were again heard occasionally until at least 3 August. In contrast, Dall and Bannister (1968:291) reported it as "rare on the Yukon".

Actitis macularia — SPOTTED SANDPIPER.* The species is ubiquitous along the river. The first downy young were seen on 4 July 1966. On 17 July, near Coal Creek, broods of recently-hatched downy young and nearly fully-feathered young were seen only a few yards apart. This disparity in the ages of broods was conspicuous on several occasions. It would be instructive to determine whether this disparity results from asynchronous nesting or attempts at renesting by some pairs.

Tringa solitaria — SOLITARY SANDPIPER.* We have only one record of several individuals in the vicinity of the Woodchopper Volcanics on 5 July 1966. The absence of records reflects our lack of work in the muskeg and pond areas away from the river. They were found in peregrine aeries at scattered locations.

Totanus flaviceps — LESSER YELLOWLEGS.* We saw it only at Circle and in the vicinity of the Woodchopper Volcanics. It was, however, found as a prey item in several peregrine aeries scattered along the river. In one aerie the legs of one were markedly longer and thicker than the others found and might have been from a greater yellowlegs (*T. melanoleucus*), although the latter would have been out of its known range.

Erolia melanotus — PECTORAL SANDPIPER. One completely intact mummified specimen was found hidden, possibly by the falcon, near a Peregrine perch above an aerie on 5 July 1966.

"PEEP" SANDPIPERS. Several small *Erolia* or *Ereunetes* sandpipers were seen in a flock flying down the river on 12 June 1966. These may have been Least Sandpipers (*Erolia minutilla*) as this species has been reported from Circle in June (Osgood, 1909) or Semipalmated Sandpipers (*Ereunetes pusillus*) as Cade found the remains of two in Peregrine aeries on the Yukon in 1951.

Limosa haemastica — HUDSONIAN GODWIT. Kessel and Springer (1966) have recently commented on the increase of the species in interior Alaska. One was observed flying and heard calling near Circle on 11 July 1966. Our attention was drawn to the bird by the actions of the flying swallows Presumably the godwit momentarily had a somewhat falconine appearance to the flying swallows, for they joined into a tight wheeling flock and followed, below and in the general course of the godwit, precisely as swallows do near their nesting colony at the appearance of a flying Peregrine (see below under swallows).

Lobipes lobatus — NORTHERN PHALAROPE.* Our only records are of three individuals found as prey remains in Peregrine aeries. The lack of records may reflect our lack of frequent visits to lakes away from the river. However, none was recorded by Cade on the lakes in 1951. Yocom (1964) lists it as a common breeder on the Yukon Flats.

Larus argentatus — HERRING GULL.* Common on the river in 1966. Observed every few miles with often three or four seen sitting together. The broad flattened region surrounding the mouth of the Charley River is especially frequented by this bird. Interestingly, only nine individuals were counted between Eagle and Circle in mid-July 1968. Cade found it to be common in 1951. On 14 August 1951, in the region of the Kandik River, he saw 21 adults and 27 birds of the year in the days travel. Some of these were associated with flocks of Mallards.

Larus canus — MEW GULL. Less common than the Herring Gull along the stretch of river from Castle Rock to Circle. Near Circle it was seen more frequently. Most of our records are of individual birds, but at Circle on 6 July 1966, a group of seven was seen. Yocom (1964) lists it as common in the Yukon Flats.

Larus philadelphia — BONAPARTE'S GULL.* Although none was seen by us in 1966 or 1968, they were frequently taken by Peregrines, presumably from around lakes and away from the river.

Rissa brevirostris — RED-LEGGED KITTIWAKE. On 4 July 1966, four miles downriver from the mouth of the Kandik River, a small gull with bright red legs and feet passed the boat about 75 feet away as it flew upriver. The solid black wingtips, with a lack of "mirrors", the red legs, small size (our first thought was of a Mew Gull) and unremarkable bill—not red—left no doubt but that it was a kittiwake. We were moving downriver as it passed us and an effort to turn the heavily laden boat upstream and pursue and collect the gull proved futile, although we were able to follow and observe it for some distance. There is but one other inland record of this species (AOU Checklist, 1957; Godfrey, 1966). The record is of an individual found dead near Fortymile, Yukon Territory, Canada. It is conceivable that the Yukon bird reached the Fortymile by following the Yukon River in a manner similar to the bird of our observation.

Xema sabini — SABINE'S GULL. This is a gull principally of coastal and insular regions and is a rare migrant to interior Canada (Godfrey, 1966). The first specimen record for interior Alaska was recently reported by Kessel and Springer (1966). On 22 June 1966, a pair of intact wings, from an adult, attached to the pectoral girdle was found in a Peregrine aerie on the river in Yukon Territory, Canada, at Castle Rock. The condition of the wings indicated that the gull had not been dead for more than 2-3 months and was probably killed during spring migration by the falcons which seemingly do not arrive on the Yukon River prior to early or mid-April.

Sterna paradisaea — ARCTIC TERN.* Our records all come from near Circle. A pair was seen on 10 June 1966, 10 miles unriver from Circle and a lone bird at Circle on 13 July 1966. Remains of one was found in a Peregrine aerie a few miles from Circle. Apparently it is more common on the Yukon Flats where the terrain is more open (Yocom, 1964).

Bubo virginianus — GREAT HORNED OWL. We failed to see or hear this species in 1966 or 1968. However, they were, like *Buteo*, numerous in 1951. Cade saw or heard them on 14 occasions or on about 31% of the days spent on the river. Squirrels, perhaps a major prey item, were also vastly more common in 1951 than in 1966. The high squirrel population was apparently a function of a good spruce cone crop as additionally indicated by the numbers of crossbills in 1951 also (see below).

Asio flammeus — SHORT-EARED OWL. Only one was seen in 1966 and that was not on the river, but on the Taylor Highway several miles from Eagle.

Aegolius funereus — BOREAL OWL. Our only record is the remains of an individual found in a Peregrine aerie near the Nation River in 1966.

Selasphorus rufus — RUFOUS HUMMINGBIRD. An adult male was seen feeding in fireweed near the confluence of Coal Creek and the Yukon River on 28 July 1966. Unidentified hummingbirds, presumably of this species, were seen by us near Eagle on 16 June and about 26 miles upriver from Circle on 5 July 1966. Antone Merly, of Eagle, told us of several hummingbirds he had seen in Eagle during the "past few years" and Frank Warren, of Circle, told us of one caught by the bill in the screen door of his house (in August 1965 according to the records of Brina Kessel). This species, although reported as occurring only in southeast Alaska (Gabrielson and Lincoln, 1959), apparently occurs sparsely in interior Alaska with fair regularity (Brina Kessel, pers. comm.). The species is probably increasing along the Yukon River and careful observations might reveal that it breeds there as indicated by our various summer records.

Megaceryle alcyon — BELTED KINGFISHER. We failed to note it on the river in 1966 and 1968, but Cade saw one in 1951 about one mile from the river along a stream. This locality was near the Fortymile River. Interestingly, Bishop (1909) never say it more than about 40 miles below Dawson. Osgood (1909) saw one at Eagle. Blackwelder (1919), aside from finding it on the Flats did not find it on the Yukon downriver from the White River. The kingfisher would seem to be a "natural" for the Yukon River because of the habitat, especially with the dirt banks for nesting holes. Perhaps the dirt banks are too ephemeral and unstable to suit kingfisher requirements or the water too turbid for effective fishing conditions.

Colaptes auratus — YELLOW-SHAFTED FLICKER.* We observed individuals near the Nation River and on three occasions near Circle. However, a total of 11 was found in Peregrine aeries indicating its greater abundance. Since flickers are receiving considerable study regarding the species and hybridiza-

tion problems, it would seem valuable to report a flicker of the "red-shafted" type seen on the Taylor Highway, 18 June 1966, between Tok and Eagle, Alaska. This lies far outside the range of the "red-shafted" type as shown by Short (1965). (*See* also Yocom, 1964, for a record of the "red-shafted" type near Fort Yukon).

Dendrocopos sp.* Only one seen briefly, thought to be a Hairy Woodpecker *D. villosus*, at the mouth of the Charley River, but tail feathers of a *D. villosus* were found in three Peregrine aeries.

Picoides tridactylus — NORTHERN THREE-TOED WOODPECKER. None was seen by us in 1966 or 1968, but Cade observed it on six occasions in 1951.

Sayornis saya — SAY'S PHOEBE.* Seen regularly along the river in areas of bluffs. Interestingly, Bishop (1900) reported seeing many until they reached Charley Creek (Kandik River) but did not observe the bird between there and Circle. Osgood (1909), however, lists it as common on the Yukon without giving further data except to say it was noted at Circle.

Empidonax flaviventris — YELLOW-BELLIED FLYCATCHER.* On 28 July 1966, an individual weighing 10.3 gm., with an ossified skull, brood patch, light fat, and ovarian follicles 1.5 x 1.5 mm was taken from a mistnet in thick willows near the confluence of Coal Creek and the Yukon River. That same day, Haugh saw another very yellow-breasted flycatcher thought to be of this species. On 24 June 1966, an intact freshly killed specimen was found near a Peregrine aerie in the vicinity of Eagle. Although it has been heretofore unknown in Alaska, these records taken together tend to indicate limited breeding of this flycatcher in interior Alaska. The current range map of the species' distribution in Canada (Godfrey, 1966; 254) shows that it extends west to the region of Fort Norman, N.W.T., thence south through the extreme southeastern tip of the Yukon Territory. If indeed the specimen taken was breeding, as indicated by its condition, and not a post-breeding wanderer, it would be of interest to re-examine the species distribution in Canada for possible clues as to the route the species followed through Canada into Alaska. The specimen was identified by Ned K. Johnson and is deposited in the Biological Collections, University of Alaska.

Empidonax traillii — TRAILL'S FLYCATCHER.* Common along the river bank. Singing birds were heard about every 100 yards on a four-mile walk from Eagle Village to Eagle on 25 June 1966. All birds calling were seemingly of the "Fitz-bew" type except for several near Eagle which tended to be a "Way-be-oh" or "Phe-be-o".

Empidonax hammondii — HAMMOND'S FLYCATCHER.*We saw it in 1966 only at a few places; principally near the Woodchopper Region and about 21 miles upriver from Circle. All individuals seen or mistnetted were associated with conifer forested hillsides. Bishop (1900) found it equally common with *E. traillii* and in the same habitat until he reached Charley Creek (Kandik River) after which he did not see it again. Our extensive mistnetting along the willows and river banks in the habitat of *E. traillii* failed to turn up any individuals of *E. hammondii*.

Contopus sordidulus — WESTERN WOOD PEWEE. We failed to see, hear, or mistnet this species. Cade recorded it several times in 1951 and collected one individual which he called a pewee.

Nuttallornis borealis — OLIVE-SIDED FLYCATCHER. We saw the species on only one occasion in 1966, but Cade saw it on five occasions in 1951.

Hirundinidae — SWALLOWS.* At Eagle four species, the Tree (*Iridoprocne bicolor*), Cliff (*Petrochelidon pyrrhonota*), Violet-green (*Tachycineta thalassina*) and Bank (*Riparia riparia*) swallows were found sympatrically in 1966. *Riparia* is by far the most numerous at Eagle, with several colonies, one of which has greater than 500 individuals. There were about 20 pairs of *Tachycineta*, 10 pairs of *Petrochelidon* and two pairs of *Iridoprocne* in the town. Although no quantitative measurement of niche utilization, such as food samples analysis, was made, a slight difference in foraging was observed among the species. *Iridoprocne* was only seen foraging near to the ground over the grassy airfield. *Tachycineta* and *Petrochelidon* foraged principally in the area encompassed by the town or somewhat overland and at an intermediate height above the ground. *Riparia* appeared to be the most versatile and was seen in all situations even back overland as far as 3-4 miles from the colony.

During most of the morning and early afternoon hours, *Riparia* foraged over the river near the colony. Daily, from about 16-1800 hours, the *Tachycineta* were seen sitting on the utility wires in town and during this time *Riparia* foraged about the resting Violet-green Swallows. All swallow specimens that we collected were found to be feeding heavily on mosquitos. Because of such an unlimited food supply, greater food "niche" separation may not be necessary during the nesting period.

One albino fledgling appeared on 18 July in the Eagle *Riparia* colony and was present until at least 22 July, at which time we left Eagle. More than 830 *Riparia*, from the colony at Circle, were counted as they sat on utility wires on the evening of 10 July. This date was prior to the fledging of young and all were considered to be adults, indicating the size of the colony.

Tachycineta was gone from Eagle by 22 July and from cliffs it occupied downriver by 28 July. It was gone by 5 August in 1951. In 1915, they were last seen by Blackwelder (1919) on 11 August. *Petrochelidon* was first noticed absent from cliffs on 27 July 1966. A *Petrochelidon* colony of considerable size about 17 miles upriver from Circle in 1966 was abandoned in 1968. *Riparia* was still common on 3 August in 1966 and a few were seen by Cade on 24 August in 1951. Blackwelder (1919) found *Tachycineta* abundant, *Riparia* "not abundant"", and only one colony of *Petrochelidon*. We found *Riparia* very abundant; *Petrochelidon* with scattered, but usually moderately large colonies; and only a few small colonies of *Tachycineta* on the lower cliffs. Osgood (1909) noted *Petrochelidon* at the Seventymile River but not elsewhere and Bishop (1900) did not record it below Dawson but believed it was not seen there because it had already migrated. Osgood (1909) called *Tachycineta* common between Eagle and Circle. In 1951, Cade recorded *Tachycineta* nearly as frequently as he did *Riparia*. There is apparently a dynamic fluctuation of not only species composition but also numbers of individuals over the years. Osgood (1909) noted the Barn Swallow (*Hirundo rustica*) at Eagle, but neither we nor Cade recorded it during the time we spent in the river valley.

Each time the Peregrine left its aerie near Eagle and flew over the *Riparia* colony, the swallows formed a tight, wheeling flock and chattered loudly, following, although somewhat below, the Peregrine course of flight.

Perisoreus canadensis — GRAY JAY.* Fairly common. On one occasion, at a locality near Circle, we found 12 freshly killed jays about a Peregrine aerie and the nearby plucking perches

Corvus corax — COMMON RAVEN.* In 1966, ravens were seen only at six localities, of which four were probably nesting areas. They were often observed in groups of 4-5, probably siblings or family groups. In 1968, however, because we were on the river about 1½ weeks earlier and at a time when young ravens were just leaving the nest, many more were seen. Eleven nesting sites were found in 1968 and the young were in the process of fledging in the first week of June. On 4 July 1966, a group of eight was seen to frequent a clump of bushes and small trees along the river toward dusk and this may have been a "communal" roost for perhaps two broods of birds. This group was seen there for a total of three days. In 1951, Cade noted the species during nearly every day of travel. A first year bird which Cade collected was beginning to molt into adult plumage on 17 July.

Parus hudsonicus — BOREAL CHICKADEE.* We only identified chickadees as *hudsonicus* on two occasions and heard or saw other parids on two different occasions that might have been *hudsonicus*. Parids on the whole were scarce. By contrast, Bishop, (1900) found chickadees regularly distributed in family or large flocks all the way to Fort Yukon. Cade noted them regularly in 1951; all recorded as *P. hudsonicus*. It is interesting to note that the black-capped chickadee (*P. atricapillus*) does not appear to have been recorded from this region. We had one record from Eagle on 20 June 1966, of an individual we identified as a Gray-headed Chickadee (*P. cinctus*). We watched it for some five minutes at about 40 feet. We will defer the recording of this bird as *P. cinctus*, however, because of the lack of a specimen or undisputed photograph.

Turdus migratorius — ROBIN.* Seen occasionally at frequent localities.

Ixoreus naevius — VARIED THRUSH.* Heard singing principally where the rivers and large streams, e.g. Coal Creek, Seventymile, Tatonduk, Kandik, Nation, etc., enter the Yukon. At the Tatonduk River on 30 June

1966, two adult females and three adult males were taken in a mist net. On 28 July 1966, about 21 miles upriver from Circle, 13 juveniles were taken in two nights of mistnetting and no adults were seen or taken. The juveniles had partially grown adult tail feathers and some adult body feathers, but all had juvenal-plumaged heads. Birds were heard singing most frequently from about 1800 hours, through the night hours, to about 0700 hours the following morning.

Hylocichla (*Catharus*) spp.* The records from some 20 nights of mistnetting are instructive in terms of comparative frequencies of thrushes. One bias in the data, however, is that all habitats were not equally sampled with regards to total number of netting nights. The Hermit Thrush (*H. guttata*) was only seen once and that was near Castle Rock, Yukon, and never taken in a net despite netting in spruce habitat. The Gray-cheeked Thrush (*H. minima*) was found most frequenlty from Circle to about 30 miles above Circle. At Circle, in three nights of mistnetting, only seven individuals were taken, as opposed to 11 Swainson's Thrush (*H. ustulata*). At Eagle no *H. minima* were taken alhtough 20 *H. ustulata* were taken in three nights of mist netting; a few *H. minima* were heard singing, however. *H. ustulata* was extremely common and appeared to be equally as common at Eagle and at Circle and points between. *H. ustulata* and *H. minima* appeared to equally frequent the same habitats along the river proper, relative to their numbers. It would be instructive to determine frequencies of these two thrushes in the Yukon Flats and partitioning of the habitat, if any. Bishop (1900) indicates that *H. ustulata* was the most common thrush. Osgood (1909) cites *H. ustulata* as abundant from Eagle to Circle and only mentions *H. minima* as being fairly common in the vicinity of Circle. Dall and Bannister (1869) also reported *H. ustulata* as more common than *H. minima*.

Sialia currucoides — MOUNTAIN BLUEBIRD. One adult male was seen on 27 June 1966 across from Eagle Village. Records for the interior of Alaska are scattered and infrequent (Kessel and Springer, 1966) but judging from the distribution map in Godfrey (1966:303), there are breeders in the region of the Yukon Territory encompassing the Yukon River. In 1951, Cade was told by Arthur Stevens, an Eagle resident, that a pair came to Eagle nearly every year.

Oenanthe oenanthe — WHEATEAR. One was collected at the mouth of Coal Creek, 20 August 1951, by Cade.

Myadestes townsendi — TOWNSEND'S SOLITAIRE.* Gabrielson and Lincoln (1959:675) state that "It is usually found at rather high elevations, particularly in the breeding season, when it is likely to be at or close to timberline." Contrary to this statement, solitaires on the upper Yukon River appear to prefer a much broader habitat type. Wherever there are drier slopes, usually south or west facing, dominated by aspen or cottonwoods with a sage, grass, or rose understory, the solitaire was found in 1966 and 1968. Young, perhaps a day or two out of the nest, were found among the aspens along the river near Castle Rock on 22 June 1966. Pairs of adults, much aroused by our presence as though a nest were nearby, were found on the drier hillsides at Calico Bluff, Montauk Bluff, and Takoma Bluff. Inasmuch as they were also seen in the spruce stands at higher elevations, their ecological tolerance in the breeding season would seem to have a much greater latitude than heretofore reported for Alaska. Paired solitaires, perhaps breeding pairs and recently fledged young, were also seen about six miles upriver from Circle on 31 July 1966, and in the first week of June, 1968.

Bombycilla garrulus — BOHEMIAN WAXWING.* Seen on five occasions in 1966 at various points on the river. Two separate individuals were watched as they "hawked" insects near Kathul Mt. on 17 July 1966. They would perch on the tip of a tall, usually isolated, spruce at the river's edge, launch forth and fly erratically about grabbing insects then return to the spruce. Seen more frequently in 1951 and sometimes in large flocks. Fledgling waxwings were found as prey items in a Peregrine aerie on 16 July 1966.

Regulus calendula — RUBY-CROWNED KINGLET. Seen or heard singing on but two occasions in 1966.

Anthus spinoletta — WATER PIPIT. Not seen in 1966 nor 1968, but Cade saw it near the Nation River on 12 and 14 August 1951.

Vermivora celata — ORANGE-CROWNED WARBLER.* Our records for *V. celata* pertain to a few birds taken in mistnets on the portion of river near Circle. No warblers were identified as this species elsewhere. An adult taken on 28 July 1966, was in heavy molt and had a newly emerging tail, with all feathers

TABLE 1.

Apparently Stable	Fluctuating Populations	More common proceeding upriver toward and beyond Eagle	More common proceeding downriver toward and beyond Circle	Apparent or actual decrease since early 1900's	Apparent or actual increase since early 1900's	Undeterminable
Canada Goose	*Buteo* hawks	White-Winged Scoter?	White-Fronted Goose	Violet-green Swallow?	Black Brant	loons spp.
Mallard	Marsh Hawk	Belted Kingfisher	Sandhill Crane	Cliff Swallow?	Pintail?	grebe spp.
Shoveler	Spruce Grouse	Hammond's Flycatcher	Northern Phalarope		Gadwall	swan spp.
American Widgeon	Ruffed Grouse	Wood Pewee	Mew Gull		Green-winged Teal	White-fronted Goose
scaup spp.	Great Horned Owl	Hermit Thrush	Bonaparte's Gull		Blue-winged Teal	Bufflehead
goldeneye spp.	Short-eared Owl	Swainson's Thrush?	Arctic Tern		Ring-necked Duck	Oldsquaw
White-winged Scoter	Violet-green Swallow?		Gray-cheecked Thrush		Kestrel	Harlequin Duck
Surf Scoter	Cliff Swallow?		Northern Waterthrush		Killdeer	Goshawk
merganser spp.	Barn Swallow?		Myrtle Warbler?		Hudsonian Godwit	Golden Eagle
Sharp-shinned Hawk	Boreal Chickadee		Blackpoll Warbler?		Rufous Hummingbird	Bald Eagle
Peregrine Falcon	Bohemian Waxwing		Rusty Blackbird?		Yellow-bellied Flycatcher	Merlin
Common Snipe	Pine Grosbeak?		Savannah Sparrow		Cliff Swallow?	Golden Plover
Spotted Sandpiper	C. Redpoll				Mountain Bluebird	Solitary Sandpiper
Herring Gull	White-winged Crossbill				Towsend Solitaire?	yellowlegs
flicker						Pectoral Sandpiper
Say's Phoebe						Sabine's Gull
Traill's Flycatcher						Boreal owl
Bank Swallow						woodpeckers spp.
Gray Jay						Olive-sided Flycatcher
Raven						Tree Swallow
Robin						Wheatear
Varied Thrush						Swainson's Thrush
Yellow Warbler						Townsend Solitaire
Slate-colored Junco						kinglet
White-crowned Sparrow						pipit
Fox Sparrow						Orange-crowned Warbler
						Wilson's Warbler
						Tree Sparrow
						Lincoln's Sparrow
						Lapland Longspur

of a uniform length, and out about 10 mm. Cade saw several on 17 August 1951 near the Charley River.

Dendroica petechia — YELLOW WARBLER.* Widespread and common on the river.

Dendroica coronata — MYRTLE WARBLER. Identified only once near Kandik River in 1966. Bishop (1900) found it commonly.

Dendroica striata — BLACKPOLL WARBLER. One record, an adult male, mistnetted on 12 July 1966 at Circle. Osgood (1900) only found it occasionally and was of the impression that it increased in numbers near Circle.

Seiurus noveboracensis — NORTHERN WATERTHRUSH.* Widespread and frequently seen, especially common at Circle. Adults were in fresh fall plumage by 1 August 1966, except for 1-3 remaining primary feathers only about one-half emerged.

Wilsonia pusilla — WILSON'S WARBLER.* Seen only on four occasions but doubtless more common. Osgood (1909) found it abundant between Eagle and Circle. Birds of the year were taken in a mistnet about 21 miles upriver from Circle on 28 July 1966.

Euphagus carolinus — RUSTY BLACKBIRD.* Seen on only two occasions, once at Miller's Camp (mouth of Tatonduk River) and once at Circle in 1966. Only two were found as prey items in Peregrine aeries in 1966, while six were found in Peregrine aeries in 1951 (Cade, *et al.*, 1968). Interestingly, it was noted only once, at Circle, by Cade on 25 August 1951.

Pinicola enucleator — PINE GROSBEAK.* Seen on two occasions, once at Eagle on 21 June and once at Circle on 12 July 1966. It was breeding at the latter locality.

Acanthis flammea — COMMON REDPOLL.* Redpolls, as compared to their common status at Fairbanks, were notably scarce in 1966. A slightly greater number was observed in 1968. It was only seen or heard at five localities in 1966. All sightings in 1966 relate to lone individuals flying high in the air, except for a flock of 15 above Woodchopper Creek and a pair near Kandik River. Only one was seen at Eagle in seven days of observations. By contrast, Cade recorded it on 11 occasions in 1951. All but two of Cade's records were in August. On 17 August, he observed a flock of 12. A female mistnetted at Circle on 2 August 1966, still had a very edematous brood patch and had been gathering food, indicating that young were in the nest at that late date

Loxia leucoptera — WHITE-WINGED CROSSBILL. Two were seen on 16 June 1966 near Eagle. None was seen in 1968. Contrastingly, Cade saw it, often in large flocks, nearly every day of travel from 11 July to 25 August 1951. These records, in addition to the numerous squirrels seen by Cade, indicated a big spruce cone crop.

Passerculus sandwichensis — SAVANNAH SPARROW.* Seen or heard only in the vicinity of Circle in 1966 where it was moderately common.

Junco hyemalis — SLATE-COLORED JUNCO.* Moderately common throughout the region, being equally so in 1966 and 1951.

Spizella arborea — TREE SPARROW.* Moderately common and widespread. More common at Circle than Eagle.

Zonotrichia leucophrys — WHITE-CROWNED SPARROW.* Frequently, but not commonly, encountered along the entire river. Most of our records come from the vicinity of Circle. Five eggs in a nest near our tent at Eagle in 1966 hatched on 28 June while on that same date, recently fledged young were seen at Eagle and a nest of three fresh eggs was found at Miller's Camp some 20 miles below Eagle.

Passerella iliaca — FOX SPARROW.* Frequently observed and heard, but not abundant, along the entire river. Most frequently seen or mistnetted in the vicinity of Circle. A juvenile on 11 July 1966 at Circle had several newly emerged adult feathers on the breast only.

Melospiza lincolnii — LINCOLN'S SPARROW.* Not commonly encountered and only seen on two occasions in 1966 and on two occasions in 1951. It would be instructive to take census counts through uniform habitat along the course of the river to determine the exact relative abundance of the passerines and the extent to which their abundance varies along the river.

Calcarius lapponicus — LAPLAND LONGSPUR. Two juveniles seen on 17 August 1951 by Cade. None was seen in 1966 nor 1968.

SUMMARY

Of the 92 species encountered during the 1966 and 1968 periods of our surveys, 57 were judged to have been breeding (marked with an asterisk). In addition to those species judged to be breeding, 14 other species seen by us, the Common Loon, Arctic Loon, Red-necked Grebe, Bufflehead, merganser spp., Spruce Grouse, Sandhill Crane, Mew Gull, Boreal Owl, Western Wood Pewee, Olive-sided Flycatcher, Ruby-crowned Kinglet, and Myrtle and Blackpoll warblers were most certainly breeding. Of those listed by us the following merit comment as to breeding status. The Blue-winged Teal has doubtlessly recently arrived as a breeder; it breeds farther north in the Flats. The Goshawk also doubtlessly breeds in the region. We would expect to find Golden Eagles, Merlins and Water Pipits breeding near timberline or in the cliff areas on the mountains immediately adjacent to the river. We would also expect Bald Eagle to breed in the region, though sparsely. Marsh Hawks, Great-horned Owls, and Short-eared Owls probably breed irregularly, possibly in considerable numbers, or perhaps annually in limited numbers depending on the size of the prey population. It is also expected that crossbills breed when the seed cone crop conditions are suitable. Three-toed Woodpeckers were doubtlessly in the region in 1966 and 1968 although we missed them. Lastly, the Mountain Bluebird may breed in small numbers annually and it is possible that, at present at least, it is near the northern limits of its breeding range.

From the above listed 26 species we feel justified in adding all, except perhaps the Great-horned Owl, Short-eared Owl, and Crossbill, as also breeding during the period of our survey. The addition of these species would bring to 80 the total number of species breeding. A perusal of the summer and distributional records from Gabrielson and Lincoln (1959) may indicate that as many as 118 species could be breeding in this region of the Yukon River.

The Pine Siskin (*Spinus pinus*) was present in conspicuous numbers during Bishop's survey (1900) as far north as Dawson and the Fortymile River. The species was not seen by Cade nor us. It has, however, been recently shown to breed in the Fairbanks region (White and Brooks, 1964) and likewise it probably breeds along the upper Yukon River. The same applies to the Brown Creeper (*Certhia familiaris*) (see Kessel and Springer, 1966). Two owls, the Great Gray (*Strix nebulosa*) and the Hawk Owl (*Surnia ulula*) were reported by either Bishop (1900) or Osgood (1909) and although not seen by us it is not surprising because of their habits. Cade did not see them in 1951 either, but he found remains of the latter in a Peregrine aerie. There is no reason to believe their status has changed since the time of Bishop and Osgood. In light of the present state of knowledge of these two owls it would be informative to determine their exact status, as it would be for all owls, along the upper Yukon. Osgood (1909) reported seeing Rough-legged Hawks (*Buteo lagopus*) commonly on the Yukon between Eagle and Circle and mentions a nest found in a spruce tree near Charlie Creek. Osgood never reported other species of

Buteo. We believe that the birds seen were actually *Buteo jamaicensis, B. "harlani"*, or perhaps the Swainson's hawk (*Buteo swainsoni*) (see Williams, 1925 and Dall and Bannister, 1869, for remarks of *B. swainsoni* in this general region), and that the citing of the hawks as *B. lagopus* was a lapse on Osgood's part. However, Dall and Bannister (1869) reported eggs of *B. lagopus* taken from a nest near Fort Yukon. Their record may lend credence to Osgood's (1909) sightings and suggest that the species has changed its distribution and it may have formerly nested along the Yukon upriver from Circle.

The status of the Barn Swallow, with repect to the upper Yukon, is open to question (*see* Gabrielson and Lincoln, 1959) and Osgood (1909) gives the only report, to our knowledge, for that region. It most certainly is not of regular occurrence. We would expect that chipping sparrows (*Spizella passerina*) will be recorded within the next few years from the region as they have been seen on the Taylor Highway just to the southwest (see Kessel and Springer, 1966: 194). We are surprised that the Tennessee Warbler (*Vermivora peregrina*) has not been recorded from this region, judging from Godfrey's (1966: 323) range map of it in Canada, but expect it to be recorded from the upper Yukon region in the near future.

No species reported from the region in the early 1900's appear to have disappeared from it although several species have become established since that time. There are, however, some species recorded by Dall and Bannister (1869) from farther downriver on the Yukon Flats that no longer appear to be breeding in that region.

The status of those species seen or listed by us, with respect to adjacent regions further upriver and downriver, and the status of the species along that portion of river we surveyed, as we tentatively interpret it, is summarized in Table 1. The literature heretofore cited is used to determine the category under which it is placed. The species of which little can be done by us concerning their status are given under the heading, undeterminable. Some species, for example the Violet-green Swallow, are given under more than one category as more than one phenomenon may be taking place. Once downriver beyond Circle, into the Flats, the nature of the avifauna and the abundance of various species appears to change rapidly (see for example Blackwelder's 1919, citation for the Belted Kingfisher; and Yocom, 1964). Two species, the Red-legged Kittiwake and Sabine's Gull, are considered as accidentals or of rare occurrence. It is probable that the Gray-headed Chickadee occurs sporadically in the region (see also Gabrielson and Lincoln, 1959: 628). It is evident from this report that a periodic surveillance of the upper Yukon River is in order to verify and further assess its breeding avifauna.

We thank Tom J. Cade and George C. West for reading this report and offering comments. Our work was supported in 1966 by the USFWS, Laurel, Maryland, and in 1968 by the Arctic Institute of North America under contractual arrangements will the Office of Naval Research.

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ALFRED EUGENE BOURGUIGNON
1893-1968

W. Earl Godfrey

National Museum of Natural Sciences

With the passing of Alfred (Fred) Eugene Bourguignon, in Ottawa on December 11, 1968, the Ottawa Field Naturalists' Club lost a highly valued, long-time member, and to a great many of us an esteemed friend. Born on June 26, 1893, in Ottawa, he was the eldest of thirteen children born to Alfred and Delia Aubrey Bourguignon.

After leaving school, Fred helped in his father's grocery, flour, and seed store, taking over the business in 1921 on the death of his father. His first hobby, in the little spare time he had in those hard-working days, was racing pigeons which he kept in his father's grain shed. In 1911, he won the O.E.P.A. prize for the best red magpie. When about 17 years of age, he began to go hunting with his father and this sparked an interest in the observing and collecting of birds that remained with him for the rest of his life.

About that time, too, he began a physical culture program at home and quickly developed into a powerful youth. Occasionally he astonished customers in the store by carrying two 50-pound bags of sugar, one under each arm. The sight of Fred cycling down the street with a bale of hay on his shoulder for delivery to a customer was a common one.

Soon he began to give physical culture lessons at home and at various schools in Ottawa. He entered competitions and, in 1920, won the Central Canada championship in both wrestling and weight-lifting. He refereed many wrestling matches. Occasionally his clothes were badly torn, and once an irate fan broke a bottle across his nose. Typically, he took this abuse in stride and carried on. He travelled considerably and met such notables as "Strangler" Lewis, Jack Sharkey, Jack Dempsey, and many more, most of whom left him their autographs testifying to his fairness.

He was one of the founders, in 1908, of the Montagnard Athletic Association whose primary purpose is the encouragement and promotion of amateur sports in Ottawa. He played on their first hockey team in 1912. Fred remained active in the Montagnard Club all his life, as its President for 40 years, and as its Treasurer during the last eight.

His interest in birds continued all the while and in 1948 he sold his business in order to have more time to devote to field study of birds and the building up of his collection. He made various trips to study birds. In 1948, he travelled extensively in western Canada and the United States; in 1949, to the Gaspe Peninsula and eastern provinces; 1958, the Gaspe Coast and Bonaventure Island, a honeymoon trip with his second wife, who shared all his subsequent trips; 1959, the Canadian prairies and West Coast; 1960, the French Islands of St. Pierre and Miquelon; 1961, various parts of Europe; 1962, a 10,000-mile trip over the Alaska Highway and return by the southern route.

He was an enthusiastic member of the Ottawa Field-Naturalists' Club and for a lengthy period he served as a Member of Council. He was especially active with the Bird Group and for years its monthly meetings were held at the Bourguignon home. Without fail, each member was individually and warmly welcomed upon arrival, and there were refreshments for all when business was over.

At one time Fred felt that the Club should have its own club house. With typical generosity, he carefully selected a good area for birds, leased the land, and erected a comfortable club house (with outdoor fireplace) at his own expense in money and effort. Indeed there are few members of long standing in the Bird Group who were not, at one time or another, beneficiaries of at least one of Fred's generous and thoughtful acts.

Over the years, he built up a superb collection of mounted birds. The entire basement of his Hare Avenue home was modified into a museum to house and display to best advantage his beautifully-prepared and accurately-labelled collection. The many groups and individuals who same to see the collection were always welcome. Bird-oriented dinner guests, after an unforgettable repast, invariably gravitated to the bird room where the remainder of the evening passed all too quickly.

Although physically powerful, Fred was gentle, kindly, modest, and generous. With no prejudices to his fellow men, he treated all with absolute fairness. He had a great, but quiet, sense of humor and love of life. His wonderfully even disposition under the most extenuating of circumstances was the envy of those who were privileged to know him well.

He was married twice. In 1921, he married Alvina Millaire, who died in 1957. In 1958, he married Marie (Molly) J. Flynn who survives.

In the course of his long ornithological activity, Fred contributed much to the stock of knowledge concerning the birds of the Ottawa region, adding several species to the list and furnishing useful data on many more. He published mainly in *The Canadian Field-Naturalist.*

During his lengthy association with birds and bird watchers he did much to create and sustain interest locally in the birds of Ottawa. His field experience and fine collection were readily available to all who asked; his car was ever ready to transport interested people to any point of ornithological importance regardless of terrain or weather; and there was always a helpful word and a smile of encouragement for those who went to him for advice.

NOTES

An Unusual Winter Movement of *Peromyscus maniculatus*

Recently Morris (1967) described a summer homing movement in *Peromyscus maniculatus* of 490 feet. Murie (1963) and Murie & Murie (1931) previously described much longer journeys by individual Deer Mice artificially displaced from their home range. The present note describes a spontaneous winter movement of a Deer Mouse (*P.m. borealis*).

The observation was made near mile post 85, Mackenzie Highway, Northwest Territories (116°44′W;60°52′N) on 20 December 1968. The ground had been covered by a permanent snow cover since 28 October but the mean depth of snow on the ground was only about 10 inches. Air temperature, recorded about 4 miles to the east at the Heart Lake Biological Station of the University of Alberta, had reached a low of -30F on 5 December, then warmed to +21 on 18 December. The minima on the nights of 18/19 and 19/20 December were -10F and -9F respectively and the maximum on 19 December was +8F. The temperature at the soil-snow interface remained between +20 and +25F from 14 to 23 December.

The forest at the point of observation can best be described as "park-like jack pine (*Pinus banksiana*)". Trees are widely spaced, there is no shrub layer and the field layer consists mainly of mosses, heaths and lichens offering little to small mammals in the way of food or cover. The small mammal population of this habitat had been sampled repeatedly during the previous four summers and was known to be always low.

My attention was drawn to an area of snow, about 6 feet long and a foot wide, at the edge of the highway right-of-way, that had been "trampled" by the repeated passage of a small mammal. On investigation, the track proved to be that of a deer mouse. Deer mice are the only cricetines in the area and their tracks in snow are readily distinguished from those of microtines. The animal had come to the surface some 925 feet from the trampled area (distance approximated by pacing parallel to the track and following its twist and turns). The animal returned by a different, more direct, route to within 125 feet of its point of origin. It then retraced its own outgoing trail and reentered the hole in the snow from which it had emerged. I estimated the return trip at 695 feet, making a round trip of about 1620 feet.

Closer examination of the trampled area revealed five holes leading to short tunnels into the snow. I excavated each of these and discovered that each ended about 4 inches beneath the surface in a small chamber. In each chamber was evidence that the animal had fed on the fruit of *Rosa woodsii*. Evidence varied from freshly nipped pedicels to partly eaten fruits and seeds left in the snow. Curiously, other fruits visible on the same stems were left untouched.

Roses are non-existent inside the pine stand, but flourish under the disturbed conditions of the roadside. It is a reasonable assumption that the "purpose" of the trip was to feed on rose hips and that the mouse knew the location of the roses from previous visits. It is also clear that the animal had no difficulty returning to its point of origin, more or less directly. It thus seems that journeys of 700 feet or so may be within the "life range" (Murie & Murie 1931) of Deer Mice

The most remarkable feature of this journey may be that it probably took place at a temperature below 0F (on the assumption that Deer Mice are nocturnal in winter as well as in summer). This is contrary to the usual habit of small mammals which avoid low winter air

temperatures by remaining beneath the snow. It is even more remarkable in Deer Mice whose winter mobility is much reduced by repeated bouts of torpor (Stebbins 1958).

The site was revisited on 2 January 1969. All sign had been obliterated by fresh snow and there was no sign of renewed surface activity. Air temperature in the area had fallen to -47F in the interim.

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First Breeding Record of the White-Headed Woodpecker for Canada

BASED on three specimens from the Okanagan and Similkameen Valleys, the White-headed Woodpecker *Dendrocopos albolarvatus* is listed as casual in central-southern Britsh Columbia (Munro and Cowan, 1947). Although not recorded as a breeding species in British Columbia, this woodpecker has been recorded by Brown (1925) nesting near the international border in the "Mountains of Okanogan County" in central-northern Washington.

On May 21, 1967, Louise V. Cooper sighted a male White-headed Woodpecker excavating a nest hole in a dead Douglas fir *Pseudotsuga menziesii* snag on lower Anarchist Mountain, three miles east of Osoyoos, B.C. The snag, about 25 feet in height, was located in a typical parkland habitat of open mixed coniferous woodlands of ponderosa pine *Pinus ponderosa* and Douglas fir with occasional patches of Saskatoon berry, *Amelanchier* sp., about 25 feet from the roadside.

On June 3 David L. Frost, Louise V. Cooper, John M. Cooper, and the writer revisited the nest site and observed the female woodpecker actively pushing chips from the nest cavity. The hole, one and one-half inches in diameter was about 12 feet from the ground.

On June 10 David L. Frost, John M. Cooper, and the writer again visited the area and found the female incubating four eggs. The eggs were glossy white with small, sharp, calcium deposits on the external shell and averaged 0.96 × 0.76 inches. Mr. Frost photographed the female at the nest hole.

British Columbia is the only province in Canada in which the White-headed Woodpecker has been recorded (Godfrey, 1966) and therefore the notes above constitute the first Canadian breeding record.

I wish to thank R. Wayne Campbell, Burnaby, B.C., for assistance in preparing this note.

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An Unusually Large, Gravid Ring-necked Snake, *Diadophis punctatus edwardsi* (Merrem) with Eight Eggs from Nova Scotia

ON June 11, 1968, about 1:30 p.m., three ring-necked snakes were seen under a large, flat rock near a pond in the vicinity of Colpton, approximately sixteen miles west of Bridgewater, Lunenburg County, Nova Scotia. One snake was noticeably larger than the other two and was the only specimen collected.

When picked up, and held in a loose grip, the reptile opened its mouth slightly and struck at my hand several times. Since I have handled more than thirty ring-necked snakes in the wild and have never been bitten this action was unexpected.

The snake, measured with some resistance, was 21⅜ inches in total length; the tail was 4⅜ inches long. The size range for adults is 10-20 inches; however, two specimens collected at Harford, New York, exceeded this range; one measured 21 inches in length, the other 22½ inches. (Wright and Wright, 1957) The Colpton specimen is the largest recorded from Canadian populations.

This ring-necked snake was kept in captivity for almost three weeks and during this time consumed five red-backed salamanders, *Plethodon cinereus cinereus* (Green), without being forced. However, the snake escaped and was not found until about six weeks later. The anterior half of the body had been devoured by carrion beetles, *Silpha surinamensis* Fab., so that only the skeleton covered by the hard dry skin remained. Within the posterior half of the body, eight shriveled eggs were found. In Michigan, 202 gravid *D. punctatus edwards* were collected, segregated in captivity and observed. The mean from the total compliment was 3.5 eggs per female. One snake laid seven eggs (Blanchard, 1937).

This specimen, with eggs, is in the Nova Scotia Museum Collection. The accession number is 68-Z-30-9(1).

I wish to thank J. Sherman Bleakney, Professor of Zoology, Acadia University, Wolfville, Nova Scotia, for commenting on the manuscript, and Barry Wright, Entomologist, Nova Scotia Museum, Halifax, for identifying the carrion beetles.

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The Highest Chromosome Number Known to Occur in a North American Plant[1]

MEIOTIC chromosomes were examined in spore mother cells of plants taken from a large population of a fern, *Ophioglossum vulgatum* L. var. *pseudopodum* (Blake) Farwell, growing 2.3 miles southwest of Ramsayville, Carleton County Ontario, 45°21′N, 75°36′W (site 1 in Greenwood 1967). The voucher specimen (Cody 18107) is deposited in

[1]Plant Research Institute Contribution No. 723.

Figure 1. Meiotic chromosomes of *Ophioglossum vulgatum* var. *pseudopodum*. X714

the Phanerogamic Herbarium, Department of Agriculture, Ottawa. Spore mother cells from these plants had *ca.* 480 bivalent chromosomes at diakinesis (Figure 1). Dr. Florence S. Wagner, University of Michigan, in a personal communication, stated that she had obtained a higher chromosome number for plants of *Ophioglossum vulgatum* L. var. *pycnostichum* Fernald from Virginia. It is therefore almost certain that *Ophioglossum vulgatum*, with at least 960 somatic chromosomes, has the highest chromosome number of any North American plant. This is not surprising, since the highest chromosome number known in the plant kingdom, 2n = *ca.* 1260, was recorded from plants of *Ophioglossum reticulatum* L. from India (Abraham and Ninan 1954).

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Early Cessation of Reproduction in an Unusually Abundant Population of *Peromyscus maniculatus borealis*

ALTHOUGH occasional outbreaks are reported, *Peromyscus maniculatus* is usually considered to be a species whose populations do not exhibit wide fluctations in numbers (Terman, 1966). This report concerns a population of deer mice of unusual abundance encountered in northern Alberta.

In the evening of 8 July 1967, 80 Sherman mouse traps were set in a poplar woodlot in the valley of the Smoky River at Watino, 40 miles south of Peace River. The traps were set in four parallel lines of equal length. Each line was approximately 15 yards apart, with the traps in each lines placed at intervals of about 5 yards. The following morning, 50 mice were collected from the traps, representing a trap success of 62.5%. For other areas of central and northern Alberta in 1967, the mean trap success was about 4%.

Four of the captured mice were *Clethrionomys gapperi athabascae*, and the other 46 were *Peromyscus maniculatus borealis*. Of the 45 deer mice which were alive, 19 were overwintered animals, (7 males, 12 females), and 26 were young of the year, (16 males, 10 females). None weighed less than 12.0 g., although juveniles weighing as little as 7.0 g. could theoretically have been captured in the traps. All of the animals seemed in excellent health, and were without obvious wounds.

Four of the overwintered male deer mice were autopsied within 3 days of their capture. All had the flaccid, darkened testes typically found after the end of the breeding season. Testicular smears revealed no spermatozoa. Nine overwintered females were autopsied a month later. All possessed placental scars, but none were pregnant, and none produced a litter while in captivity, although breeding normally extended through August in this region. None of the young deer mice captured were sexually mature, and none became mature during 2 months of captivity. Reproduction appeared to have ceased in this population.

Three of the four red-backed mice captured at Watino were females. All three were pregnant at capture, and produced normal litters. The male was also in breeding condition.

The same small area at Watino and adjacent areas were trapped again in 1968, on 25 June, 12 July, and 1 September. Overall trap success was 3.7%; in 615 trap nights were captured 1 *Clethrionomys gapperi* and 23 *Peromyscus maniculatus*. Ten of the deer mice had overwintered.

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The Fluoride Content of Water from Wells in the Greater Ottawa Area

SOME 120 cities and towns in Canada and 2500 cites and towns in North America add fluoride to their water supplies as a caries preventive. The fluoride concentration is generally maintained between 0.8 and 1.2 ppm for this purpose. Fluorides are also present in varying, but appreciable amounts in well, spring, and stream waters.

The fluoride content of water from 24 wells in the greater Ottawa area was

TABLE 1. — Fluoride Content in Parts per Million of Well Waters from the Greater Ottawa Area and of Ottawa City Water

Well Number	Fluoride Content	Well Number	Fluoride Content	Well Number	Fluoride Content	Ottawa City Water Sample No.	Fluoride Content
F1	0.20	F9	0.65	F17	0.80	1	1.02
F2	0.27	F10	0.26	F18	0.95	2	1.13
F3	0.25	F11	0.27	F19	1.41	3	1.05
F4	0.32	F12	0.66	F20	0.10		
F5	1.14	F13	0.32	F21	0.12		
F6	0.30	F14	0.93	F22	0.02		
F7	0.36	F15	0.65	F23	0.25		
F8	0.28	F16	0.04	F24	0.12		

recently determined. The wells that were sampled were distributed from Dunrobin to Kemptville, but at least 30 per cent of the wells were from Nepean Townhip and a few were from within the city. A lanthanum chelate of alizarin complexone was used as a color indicator (1). All analyses were done in triplicate. Three samples of Ottawa City water collected over a five day period were similarly analyzed. All results are recorded in the table below.

The fluoride content of Ottawa City water ranged from 1.02 to 1.13 ppm over the 5 day period. The well waters ranged from 0.02 to 1.41 ppm with a general background between 0.25-0.30 ppm. Only two wells (F16, F22) had extremely low fluoride contents. It is informative to note that approximately one third of the well waters have a fluoride content equivalent to or approaching that considered desirable as a preventive for caries.

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Breeding Records of the Ring-necked Duck in Gaspé South County, Québec

THE present status of the Ring-necked Duck (*Aythya collaris*) in Québec is rather poorly known (Mendall, 1958). Waterfowl investigations carried out in river estuaries opening into Gaspé Bay and on inland lakes in Gaspé South County have revealed the presence of breeding Ring-necked Ducks.

From mid-June to mid-August 1965, while working for the Québec Wildlife Service in Gaspé, I conducted weekly brood counts by canoe on the York River Estuary and also made some observations on inland lakes. Twenty-four broods of seven species were seen. Four of these were Ring-necked Duck. Although no brood counts were made in 1966, I saw a brood of Ring-necked Ducks on the York River at the end of July during banding operations.

Reed (1966) suggested that the Ring-necked Duck was the third most common breeding duck on the inland waters of the lower St. Lawrence counties of Rivière-du-Loup and Rimouski. He found the black duck (*Anas rubripes*) and the common goldeneye (*Bucephala clangula*) to rank first and second in abundance. The observations reported

here seem to indicate that the same hierarchy prevails in Gaspé South County.

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Accepetd March 20, 1969

The Golden-winged Warbler in Muskoka County, Ontario

SNYDER (1957) has shown that the Golden-winged Warbler, *Vermivora chrysoptera*, has expanded its breeding range some 150 miles northward during the present century and he mentions that it is now found sparsely north to northern Simcoe County. Devitt (1967) records that it was first reported in Simcoe County on June 11, 1929 and states that it since has become an uncommon summer resident in that county.

Indeed, the species now is a summer resident still farther north in various localities in southern Muskoka County. Between June 12 and 30, 1967, while doing field work in Muskoka County, the writer recorded the Golden-winged Warbler at the following places in southern Muskoka County. One was observed on various occasions two miles east of Gravenhurst, one four miles east, and one nine miles east. Near Kilworthy one was noted on June 15 and another on the following day at Morrison Lake. One was observed at Vankoughnet on June 18. At least 12 individuals were noted in the Torrance region between June 20 and 30 and specimens were collected. In most instances the habitat favored was moist to wet alders and willows.

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Accepted March 15, 1969

Early Emergence from Hibernation of the Rubber Boa

ON February 24, 1968, Mr. D. K. Campbell, a biology teacher at Vernon Senior Secondary School, discovered three rubber boas (*Charina bottae* (Blainville)) basking on the surface of a south-facing talus slope near Westwold, B.C. Two snakes were curled up together and the third, also curled up, was about 6 feet away.

The maximum temperature recorded at the Westwold weather station on this date was 56°F, and warm daytime temperatures had prevailed for the preceding six days. This early emergence is nevertheless surprising, considering that in a locality subject to winter temperatures as low as -40°F the snakes' hibernating quarters would, of necessity, be well below the surface of the talus.

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Accepted April 19, 1969

Burrows of the Pallid Vole, *Lagurus curtatus*, in Alberta, Canada

COMMENTS on the habitat of this vole have been reported by Bailey (North American Fauna 49: 17-226, 1926) and Moore (Canadian Field-Naturalist 67: 154-156, 1953). These authors obtained pallid voles in highland half barren areas where scanty vegetative cover included silver sage, blazing star, winter fat cactus, sagewort, club-moss, and grasses. They noted holes and well worn runways of these animals but did not describe their burrows.

It was gratifying therefore, while collecting these animals during the early summer months in Alberta, to find several active colonies of the pallid vole. These colonies were located 13 miles southwest of Scotfield, Township 29, Range 10 west of fourth, Alberta, Canada.

Within an area roughly one-half square mile seven colonies of pallid voles were located. These colonies were restricted to definite ecological and microgeographical areas. Colonies were located on knolls which were only slightly elevated above the flat prairie terrain. Vegetation of grasses and silver sage were always more abundant, or at least more concentrated on each knoll, so that each area colonized was greener than surrounding areas. The average size of each knoll was 43 by 45 feet. At least 20 holes were found on the surface of each knoll. Each opening, leading to a network of tunnels, measured one and one-half to two inches in diameter. Entrance to these holes was surrounded by a typical mud mound. An area of one to two inches in circumference surrounding each mud mound was denuded of vegetative cover. Several well marked runways lacking vegetative cover led to each opening. In an effort to obtain information relative to the tunnels and burrows of these voles, 10 burrows were excavated. Each opening led to a short shelf just under the surface of the ground. From this shelf the tunnel continued downward in a sigmoid pattern. There were usually two antichambers, two to three inches in diameter, one on either side of the tunnel, and located approximately six inches below the surface. Below the antichambers, tunnels extended downward to an average depth of 14 inches where horizontal interconnecting passageways were numerous. The fact that these tunnels were interconnected, at least in part, was apparent from the following account. While standing in the middle of one colony, I was able to catch a young animal alive. This animal was tagged, carried to a hole a distance of 10 feet from the hole in which it was taken, and allowed to enter this hole. By the time I walked back to the point of original capture, the animal reappeared and was identified as the same tagged animal. Excavated tunnels averaged one and one-half inches in diameter. These tunnels, antichambers, and the shelf just below the surface, were all littered with grass and silver sage. Since these animals were observed eating grass and silver sage, it seems probable that pallid voles maintain a reserve food supply at all subterranian levels of the burrow.

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First Alberta Record of the Band-Tailed Pigeon

ON the evening of the 27 July, 1967, Mr. Harvey Burns was on his property at Leduc, Alberta, in the parkland about 20 miles South of Edmonton. He observed a group of Purple Martins, *Progne subis* (Linnaeus), diving on a bird largely concealed in a tree. Thinking the

bird to be a predator that had been molesting the martins, he shot it.

On examination, it proved to be a Band-tailed Pigeon, *columba fasciata* Say. Recognizing the species, Mr. Burns realised its significance, and took the specimen to Dr. C. Hampson. One of us (M. J. H.) mounted it for the Provincial Museum and Archives of Alberta (Registration No. Z67.32.1).

The bird is an adult female in good condition, with no indication of abrasion of the feathers to suggest it might have been in captivity. The bird was fat and healthy, and no external parasites were discovered. The crop was crammed with Saskatoon berries *Amelanchier alnifolia* Nutt., and there were no eggs present.

The summer had been hot and dry, with no unusual storms. The weather at the time of collection was clear and fine. The Band-tailed Pigeon breeds in Britsh Columbia and Utah, but has not previously been recorded in Alberta.

DAVID A. E. SPALDING
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Accepted March 20, 1969

LETTERS

NUPTIAL FLIGHTS OF THE ANT, *Lasius pallitarsis*

THE report "Swarming and Mating in the Ant, *Lasius sitkaensis* Pergande" by Corbet and Ayre (1968) is of considerable interest because of the record of almost 35 miles of synchronous and nearly continuous swarming of ants. Although several authors have concluded that flights will occur concurrently from many of the mature colonies in an area, Corbet's observation is unique in its extent.

The swarming behavior described by Corbet and Ayre is typical of *Myrmica* spp. (see Neudecker, 1952) and many other Myrmicine genera, but not of *Lasius* at least North American *Lasius*. Some early references to *Lasius* flights mention swarming (Wheeler, 1910; Donisthorpe, 1927) but these descriptions of alate activity are either vague or else refer to random movements of alates in the air. More recently, Sudd (1967) has stated that swarms of the European ant, *Lasius niger*, "may form large clouds." Sudd goes on to cite observations of swarming by Polimanti (1911), but Polimanti's observations were of *L. niger* alates attracted to street lights at dusk, hardly an appropriate reference to swarming. A positive assertion of *Lasius* swarming was made by Collingwood (1958) who stated that "vast swarms of *Lasius niger* L. and *L. flavus* F. have been frequently recorded in this country (Great Britain) especially in the south where clouds of these ants have sometimes been observed . . . " Unfortunately, no references were cited. The possibility that *Lasius* alates may form swarms should be anticipated because various types of swarming behaviour have been observed in other formicine genera, including *Brachymyrmex* (Arnaud and Quate, 1951), *Prenolepis* (Talbot, 1945) and *Formica* (Chapman, 1954, 1957; Talbot, 1959, and Kannowski and Johnson, 1969).

On Oakville Prairie, an 800 acre field station of the University of North Dakota located twelve miles west of Grand Forks, the climatic conditions that favor the flights of *Lasius sitkaensis* (comparable to those listed by Corbet and Ayre) also favor the flights of *Lasius neoniger*, *L. umbratus*, *Myrmica fracticornis* and *Bra-*

chymyrmex depilis. Consequently, alates of all five of these species often may be observed in the air over this locality at the same time on the same day. In 12 years of study of ant flights at Oakville Prairie I have observed many flights of alates from the nests of these species.[1] Even though the air from 2-20 meters above the prairie is populated with hundreds of thousands, perhaps millions, of alates, only the Myrmicas have been observed to form swarms of the type observed by Corbet. On Oakville Prairie the *Lasius* alates have always been observed to fly randomly in a horizontal pattern over the field. The act of attraction of the much smaller males to the females has not been observed, but copulating pairs are numerous in the air on a flight day. These copulating pairs fly the same horizontal pattern as the unmated alates. After copulation, the newly mated females, and sometimes the mated pairs, fall to the ground. There, the females usually flick off their wings by swift leg movements and begin the search for a new nest site. The males fly off, presumably to attempt other matings.

We know very little about the flight and mating behaviour of formicine ants, but it does seem strange that a common and widespread species should exhibit such a difference in behavior in two localities which are near the center of the species' range. I believe that there are two ways of accounting for this: 1) swarming may occur only in certain ecological environments (e.g., in a forested region such as southeastern Ontario the alates may gather in the open roadways or over landmark trees, while in the nearly treeless prairies a non-swarming type of behavior may occur); or 2) the association with the swarms was erroneous.

What is disturbing about the Corbet and Ayre report is the presumed association of two mated pairs of *L. sitkaensis* with the swarms. These authors stated that "ants *seen or caught beneath swarms.* [italics added] at about 1700 hrs. E.S.T. were all mating pairs. Two such pairs, in fresh condition, were identified (by G. L. A.) as *Lasius sitkaensis* Pergande. It is likely, though not certain, that the whole swarm comprised this species." We are asked to accept the swarms as being composed of *L. sitkaensis* alates without any assurance that these two pairs were part of the swarms. Had the sample been collected directly from a swarm and a larger number of specimens preserved, a more certain association of species and behavior would have been possible.

Corbet and Ayre cite this Ontario occurence as "probably the first authentic record of a nuptial flight for this species . . ." In so doing, they overlooked the description of flights of *L. sitkaensis* in New Mexico by Medler (1958) and additional references to the flight period and environmental conditions favorable to flights of this species in North Dakota by Kannowski (1963).

Finally, Francoeur and Beique (1966) showed that *L. sitkaensis* Pergande is a synonym of *L. pallitarsis* (Provancher). The validity of this synonymy has been accepted by E. O. Wilson (personal communication) whose revision of *Lasius* (1955) is the most recent taxonomic study of the genus.

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[1]Part of this research has been supported by a grant (GB-6514) from the National Science Foundation

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SWARMING AND MATING IN THE ANT, *Lasius sitkaensis* PERGANDE: FURTHER REMARKS

Kannowski's comment on our article relates to three questions (listed here in reverse order):

1. Nomenclature of the specimens collected.
2. Priority of the observation as a record of nuptial flight in *L. sitkaensis.*
3. Whether or not the specimens collected were representative (a) of the swarm above them, and (b) of the other swarms along the 35-mile stretch of highway.

Questions 1 and 2 are essentially procedural.

1. We were remiss in overlooking the recent synonymy (Francoeur and Beique, 1966) involving *Lasius sitkaensis* Pergande and *L. pallitarsis* (Provancher). (The determination and identity of the specimens are not in doubt.)
2. Whether or not Medler's (1958) record can be classed as a "nuptial flight" depends on the meaning assigned to this term. In our article we used the term to comprise "swarming and associated mating." We have since learnt from Kannowski (*in litt.*) that he does not regard swarming as a criterion of nuptial flight. Specimens seen by Corbet were mating and flying in a swarm; alates seen by Medler were "clustered around emergence holes until late afternoon, dispersing gradually by flying away singly rather than swarming". We could usefully have cited Medler, if only to note the contrast between his observations and our own. It would have been useful also to cite Kannowski's article (1963) on weather conditions conducive to swarming. Citation of neither references would have changed the substance of our report.

3(a). It was Corbet's recollection that the specimens were caught in two ways: by the collector leaping up and snatching them from the base of the swarm; and by the collector picking them up (from the ground or an automobile

top) as pairs seen falling out from the swarm. To check this, the three scientists who were his companions on this occasion were asked, independently and without prompting, to recall how the specimens were captured. All said that the captured specimens had been "definitely part of the swarm". Only one was sure how the ants were collected and he confirmed Corbet's recollection as recorded above. No one's report conflicted with it. As far as it is possible to obtain incisive evidence for such a thing, it must be concluded that the specimens captured mating were part of the swarm above the collector. Whether or not this swarm was homogeneous we cannot (and did not) say, and upon this depends the answer to this question. Kannowski (above) has observed composite swarms of this type and so this possibility must be entertained in this case.

3(b). Collections were made from one point only. It was the similarity in gross appearance of the other swarms that led us to say it was "likely, though not certain" that all comprised the same species. This also must remain an open question until the observations can be repeated with a better opportunity being offered for sampling different parts of the swarm. Certainly our observation does not exclude the possibility that some or all of the other swarms comprised other species.

It is hoped that our observation and Kannowski's pertinent comments will encourage other naturalists in North America to make more extensive collections that will resolve these questions. Exactly one year after our observation, similar swarms were reported near Belleville in Eastern Ontario. If such swarming occurs annually we shall hope ourselves to document it in greater detail in future years.

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May 13, 1969

ON A NATIONAL NATURALISTS' ORGANIZATION

Further to Dr. M. T. Myres' appeal for a National Organization for Canadian Naturalists (C.F.N. Vol. 83, No. 1, 1969), I would like to add one thought.

Having worked in the Lands Section of the Canadian Wildlife Service for a short period of time, it has become apparent that the public is becoming increasingly aware of the need to preserve natural areas. Very often, individuals wish to make bequests of land, or of money to purchase land. There are a number of foundations which have funds to be used in this way but in each case there is probably some uncertainty as to how the land or money can be put to best use. Here then, is one important need for a national organization which would identify these areas which should be purchased and then buy them. It would be hoped that agreements could be reached with Provincial and Federal Governments to purchase them back for public use – if this were found desirable. The main advantage here would be the relative speed with which a private organization could move, in securing the rapidly disappearing natural areas.

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June 3, 1969.

REVIEWS

Flora of the Queen Charlotte Islands: Part I. Systematics of the Vascular Plants

By James A. Calder and Roy L. Taylor, xiii + 659 pp., illus. $12.50; and Part 2, **Cytological Aspects of the Vascular Plants** By Roy L. Taylor and Gerald A. Mulligan, ix + 148 pp., $7.50. Canada Department of Agriculture, Research Branch, Monograph No. 4, 1968. Available from Queen's Printer, Ottawa.

The Amphi-Pacific segment of the Circumpolar Flora is extremely interesting and complicated since the continents of Asia and America have been linked in the north by mountain and coastal migration highways at one time or another for a very long time. Elements of the Tertiary Flora which have used these highways have surviving close relatives deep in the two continents as far apart as the Southern Rocky Mountains and the Altai-Pamir region of Asia.

The Atlantic aspect of the Circumpolar flora has been well-known and thoroughly studied for over a century, but although the existence of Tertiary connections involving eastern Asia and Eastern North America was discussed a century ago by Asa Gray, the obvious possibility of more extensive floristic connections between Japan and western North America has not been thoroughly explored, at least in the long arc of the Pacific Coast between Washington and Alaska. The Flora of the Queen Charlotte Islands deals with the most significant segment of this gap, which, until the present study, was virtually unknown territory.

The Flora represents a distillation of what must be the most thorough investigation of such an area in recent times, accomplished through team work uniting some of the most competent and critical field botanists it has been my privilege to know. Although Part 3, the Bryophytes, has not appeared at this writing, this statement can be extended to anticipate the latter survey by W. B. Schofield.

This flora appears at a time when there is intense activity on flora-writing involving the northwestern United States, Alaska, The Aleutian Islands, and Japan – independent studies by students having widely differing geographic and taxonomic frames of reference. The facts are not all in and for some time to come we should expect to endure considerable fluidity in nomenclature of the plants of this vast area, and in specific and generic concepts. Non-taxonomists evidently need to be reminded often that nomenclature is the shorthand which taxonomic scientists use to express their various points of view. Only in a limited sense is one name "right" and another "wrong". Expression of varying viewpoint is the right of every scientist; in fact, to be able to express complex points of view by a binomial is economical as well as useful. To ask the taxonomists to "once and for all get together and stabilize their nomenclature". would be to deny them the right to differ, which is regarded as sacrosanct in all other branches of research. This Flora struggles with the taxonomic concepts utilized by past workers and with those in current use. This is a good sign, for it means that conversations are occurring and old notions are being challenged. We should be willing to wait a reasonable time for stabilization of nomenclature.

One real value of part 1 is that the authors give critical evaluations of the taxa, together with perceptive discussions of floristic ecology, and they present honest discussions of their taxonomic positions where these are too often reduced, in monographs and floras, to mere lists of synonymy. Detailed introductory chapters on history, physiography, geology, climate, economic botany, plant communities and phyto-

geography help to make this an ideal floristic treatment.

European students will find reason to criticize the book for its failure to account for some of their literature. For example, the authors seem to have been unaware of Björkman's work on *Podagrostis*, Hylander's critical studies on the taxonomy and nomenclature of the Scandinavian flora, and others. Although regrettable, a certain amount of provincialism must be allowed floristic writers since their field of bibliographic responsiblity is too vast to handle without the computer.

The quality of work and the proficiency of the workers leaves little to be desired. However, it is difficult to understand the division of the book into separate parts, or to understand the rather elaborate use of color in a book with rather limited appeal to the amateur or layman. The color photographs have suffered badly in reproduction.

Without intending to criticize the research accomplished by Taylor and Mulligan, Part 2, in my opinion, is a sheer waste of paper. Its subject matter could have been condensed to form an appendix to the first volume or run directly into the text under the respective taxa. Each of the 568 taxa is listed by name, with ample space above and below the entry, whether a chromosome count was obtained or not. The dust jacket claims that 71% of the taxa were analyzed cytologically. However, most of the counts agree perfectly with earlier ones by other workers in other regions, and most of the discussion simply seems to consist of different ways of saying that this or that count is identical to one reported elsewhere. Surely the cytotaxonomists can find some symbol by which this information could be conveyed. The cytological volume has no illustrations of karyotypes or metaphase plates which would lend interest to this volume.

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Growth and Utilization of Poplars in Canada

By J. S. MAINI and J. B. CAYFORD (Eds.), Forestry Branch, Canada Department of Forestry and Rural Development, Ottawa, Publ. No. 1205. Illus. vii + 257 pp., 1968. Paperback.

The various species of poplar which are found in Canada are a most important economic resource. In February 1967 a symposium was held at Harrison Hot Springs, B.C. to discuss the status of poplar in Canada. All aspects from silvical characteristics through breeding, parasites and utilization were treated. The papers presented have been reproduced in book form together with three additional papers which introduce and give broader coverage to the subject.

Undoubtedly there were many Canadian foresters and other interested individuals who were unable to be present at these meetings, so it is most fortunate that these papers have been reproduced. The information provided will thereby be available to workers in all parts of the world where poplar is an important forest tree. The bibliographies which accompany the papers are for the most part quite extensive.

Of particular interest to the readers of this journal are Chapter 1: Landscape and climate of Canada by J. S. Maini; Chapter 2: Silvics and ecology of *Populus* in Canada by J. S. Maini; and Chapter 7: Insects and diseases by A. G. Davidson and R. M. Prentice. These, and particularly the first and last might be of special interest in biology classes in our schools, but unfortunately will probably never be seen there.

Chapter 1 is a brief description of the physiographic regions, climatological zones, soils, vegetation regions and vegetation – environment relationships in Canada. Six maps illustrate these factors. This material is all available elsewhere, as the extensive bibliography indicates, but is brought together in a readily understood form.

In Chapter 2 Dr. Maini gives detailed descriptions of the seven native species of Canadian poplar, provides keys for both leafy and winter twig conditions, and presents some excellent photographs of leaves, twigs, bark and fruit. Mention is made of Pleistocene and post-Pleistocene poplar distribution, and paragraphs on the modern distribution of each of the Canadian species together with three coloured distribution maps are given. Phenology, reproduction, development and growth, biotic, climatic and edaphic relationships are also discussed.

Again, Chapter 7 deals with Insects and Diseases. According to the authors, at least 300 species of insects and 150 fungi have been recorded by the Forest Insect and Disease Survey on living trembling aspen alone. The major species of these are described, together with the damages they cause. Natural control, control by man, and other points of interest are discussed. Eleven excellent photographs illustrate this chapter.

The text is typewritten; reproduction is by offset on a glossy paper.

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The Sociology of Nature

By LESLIE REID. Pelican A556, Penguin Books Ltd., Hammondsworth, Middlesex 6/- 1962.

This book of 278 pages is the best value for money in the field of elementary ecology texts. It deals with individuals and communities, changes in both, and with learning, movement and dispersal, colour and pattern and all their interrelations. Each chapter begins with an apt quotation from Darwin or a well known poet or philosopher. The author's wide experience in Canada and Europe have helped him to write about the complexity of ecology with a freshness and clarity that makes for easy reading and understanding.

While most of the book is descriptive the author has drawn a timeless conclusion. "We are beginning to realize now that ecology is a science of the utmost practical importance, that it is not radioactive strontium that threatens the future of mankind but neglect of the teachings of ecology".

Many international scientific meetings in 1968 and 1969 reached the same conclusion. A recent Gallup poll has shown that the public is finally beginning to react to the situation. Reid's mastery of the subject put him 10 years ahead of most people in understanding the growing importance of ecology.

No well-informed naturalist should be without this delightful book.

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Man and Environment: Crisis and the Strategy of Choice

By ROBERT ARVILL, Pelican Original A889, Penguin Books Ltd., Hammondsworth, Middlesex, England. 332 pp. 8/6 (U.K.) 1967.

In the preface the author, who uses the pseudonym Robert Arvill, states: "This book is about people; about their impact on land, air, water and wildlife, and the environment they create; about the damage and the destruction they

cause and the measures they take as a society to remedy this. Above all, it is about the possibilities they now have to re-shape and create an environment that fits their highest aspirations".

In reviewing man's impact on the world the author reminds us that it took man about 200,000 years to achieve a population of a billion, but only an additional hundred years to reach 2 billion. With a world population of 3½ billion in 1966 the most recent doubling of population will have occurred in about 35 years. Although many countries have a higher rate of increase, the arrival of a new baby every 12 seconds in the United States coupled with the production of a new car every five seconds together lead to the loss of two acres of countryside every minute. The author reminds us that there are now about 25 million square miles of habitable and cultivable land in the world. He contrasts that with the 780 square miles of land that are taken out of cultivation *a day* for urban expansion, roads, industrial expansion and by erosion. Those figures give us an idea of the urgency of our present problems.

The author treats land in its agricultural, forestry, wildlife and recreational context. He goes on to review the problems of air and water pollution and their complex relations to the rest of the fabric of ecology. There are two chapters on wildlife, which are introduced by a couplet from Alexander Pope's Essay on Man: "From Nature's chain, whatever link you strike, Tenth or ten thousandth, breaks the chain alike".

Under the heading of "Unities" there are useful discussions of famous wetland areas which typify biological complexes. They include the Everglades of Florida, the Norfolk and East Suffolk Broads of England and the Camargue of France. In each case conflicting uses of the areas have led to unintended results in these ecologically fragile environments. Some similar occurrences in the United Kingdom involving areas other than wetlands are also reviewed.

The last six chapters deal with increasing numbers of people, the impact of their leisure activities on the land and the need for planning of land use to ensure minimum destruction of habitat.

Although much of the book is oriented toward problems as they exist in the United Kingdom, the ideas presented are useful anywhere. A useful 21-page appendix closes with a Chinese proverb: "The art of life lies in a constant readjustment to our surroundings".

There are 16 pages of photographs. The text is clear and free from errors.

All concerned persons interested in natural history and the future of the earth as a place to live should read this book.

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The Flora of Nova Scotia

By A. E. ROLAND and E. C. SMITH. Part I. The Pteridophytes, Gymnosperms, and Monocotyledons. Proc. N.S. Inst. Sci. 26, part 2: 3-237, 1963-1964 (published 1966).

The original Flora of Nova Scotia by A. E. Roland appeared in Volume 21, Parts 3 & 4, 1944-46 (published 1947) of the Proceedings of the Nova Scotia Institute of Science, and this part of the new edition which has picked up an additional author appears in volume 26, part 2, 1963-1964 (1966). At the time of this writing, the second part was in press.

The first edition has not been available for some time. It is gratifying, therefore, to see the new edition appear. The text has been rather thoroughly revised; keys, discussions under individual species and statements of range have been rewritten,

expanded or altered as needed. The dot maps use the original base map but have been replotted to incorporate the extensive records accumulated by J. S. Erskine, W. B. Schofield, D. H. Webster and others since the first edition appeared. Because the maps include Prince Edward Island, the distribution maps of David Erskine's flora of that province have been incorporated. Recent monographs have been consulted where available but the old style of discussion of varieties and forms following each species has been retained. The genus *Potamogeton* has been written by D. H. Webster, the genus *Eleocharis* by W. B. Schofield and the Orchidaceae have been influenced by J. F. Donly's treatment of the group for the province. The grasses which were completely omitted in the first edition, are now included. They are taken from the treatment by A. E. Roland and W. G. Dore (The Grasses of Nova Scotia, Proc. N. S. Inst. Sci. 20: 177-288. 1942). The Carices (as in most floras) are based on the work of K. K. Mackenzie (North American Flora 18: 1-478. 1931-35.

The sequence of families follows M. L. Fernald's 8th edition of Gray's Manual which is that of Engler and Prantl. The first edition followed the sequence of the 7th edition of Gray's Manual. This means that the new flora begins with the horsetails rather than the ferns. There are no species descriptions and identification depends wholly on the dichotomous keys plus the illustrations as it did in the first edition. Illustrations, exclusive of the Gramineae and three *Potamogetons* are the same as those used some 20 years ago, but judging from the results, probably reproduced by offset. A few of them should have been replaced and this oversight significantly detracts from the attractiveness of the manual. For example, the illustration of *Lycopodium* on page 17 is still little more than a silouette and that of *Pontederia* and *Eriocaulon* on page 191 is altogether too light. The new grass plates are excellent although the identity of the illustrator is not given. There is a small glossary, a page and a half of bibliography and an index. It is hoped that when the two parts are ultimately combined this will be expanded. In this edition the type style is sharp and a high quality glossy paper is used.

The authors are to be congratulated on a fine job of revision and incorporation of new data without loss of the original style and format.

JOHN M. GILLETT

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Ottawa

Living With Your Land: A Guide to Conservation for the City's Fringe

By JOHN VOSBURGH, Bulletin 53, Cranbrook Institute of Science, Bloomfield Hills, Michigan 48013. 7 + 149 pp., illus., 1968. paperback $1.00 (U.S.).

The subtitle sets the tone of this attractively designed paperback.

While the book offers hints to suburban land owners it is directed mainly to those who, having for the first time moved beyond the city, face the hazards of slightly "wilder" land. Beginning with soil and its properties as a good or bad base for a building, the author goes on to cover erosion and its control. From land-holding plants to shelterbelts which moderate the extremes of climate is an easy and logical step. A wide variety of animals and plants of the countryside – skunks, deerflies, grouse, turtles and poison ivy to name but a few – are shown to be both objects of interest and also, at times, problems to the householder. The author outlines ways to attract wild creatures or, if necessary, to keep them under control.

The democratic approach in dealing with community problems, from objectionable billboards to land trespass, is stressed. Each landowner has a strong weapon in his ballot.

Appropriate line drawings and sketches appear throughout the book and there are 16 pages of photographs. The type, though small is easily read and free from errors.

New rural dwellers will find much useful information in the book. Even experienced naturalists will learn from it.

V. E. F. SOLMAN

Canadian Wildlife Service,
Ottawa, Ontario.

OTHER NEW TITLES

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HARVARD UNIVERSITY

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TOWARD LEGISLATION TO PROTECT YOUNG PEREGRINE FALCONS

A historically significant conference may have taken place at Cornell University, New York, on November 4 and 5, 1969; decisions reached and actions taken could well determine whether the swiftest flying of all living things, the Peregrine Falcon, will survive as a wild breeding bird in North America. The conference was planned by Dr. Tom J. Cade, Director of the Laboratory of Ornithology at Cornell, and was sponsored by the Laboratory. It was attended by many United States and Canadian scientists who strongly reaffirmed that the Peregrine is an increasingly endangered species in all of North America and they called on governments of the United States, Canada and Mexico to take strong measures to preserve the species from extinction. Following the conference, Cade, as chairman, sent letters to the Secretary of the U.S. Department of the Interior, the Minister of Indian Affairs and Northern Development in Canada and to the Secretary of Agriculture, in Mexico expressing "deep concern" about the status of the Peregrine and urging the three governments to take whatever action is needed to preserve the species. Parts of the letter read:

> "From present evidence, it is probable that all remaining North American Peregrine populations are affected to some degree by pesticide contamination, and if the Peregrine is to survive as a species, it is absolutely essential that the use of DDT and related poisons be stopped as soon as possible. The problem transcends the boundaries of state and provincial jurisdictions and is truly international, as migrant Peregrines that breed in arctic Alaska, Canada and Greenland pass southward to winter as far away as Argentina. — If DDT and derivative residues reach levels of 30 parts per million or more in the brain, death is likely; and there are several documented cases of falcons found dead with pesticide concentrations of this order in their brains. The evidence is also clear that sublethal accumulations of pesticide residues affect reproduction in falcons, with the result that the annual production of young birds is insufficient to replace losses in the adult breeding populations. The combined effects of direct mortality and reduced reproduction rate have been responsible for the virtual extinction of the Peregrine as a breeding bird in many parts of its former range in both Europe and America."
>
> "In the United States, there are no longer any Peregrines breeding east of the Mississippi River, and surveys made in the past three years show that the disappearance of breeding pairs at long known nesting sites has continued westward and northward on the continent. Only remnant populations remain in the Rocky Mountains, in Alberta, and along the West Coast from Washington to Baja California. Even some remote arctic Canadian populations have declined recently."
>
> "The current trend toward a sharp reduction in the uses of DDT and other hard pesticides offers some hope that the Peregrine Falcon will not be completely extirpated from North America. The decline of the Peregrine

Mailing date of this number: 31st March, 1970

in Great Britain has evidently stopped, following a reduction in the use of pesticides there. But even after all use of persistent pesticides ends, residues of the chlorinated hydrocarbons will remain as contaminants in the environment for many years to come, so that Peregrine populations will continue in a precarious state for the indefinite future."

"In order for the Peregrine to make a comeback as a species and to regain range it has now lost, *it is essential that the remaining breeding populations be protected from unnecessary molestation and that the survival of each year's young birds be maximized.* With the present greatly reduced population size and lowered reproductive success, *the taking of Peregrines for any purpose should be carefully regulated.*" (Italics mine).

It seems clear that if governments act soon to pass legislation that would impose appropriate penalties to prohibit "the harvesting" of young Peregrines from their nests, these birds may, given time for the environment to cleanse itself, be saved from ultimate extinction. It is interesting and historically significant that the following press release was issued from the office of the Hon. William Kenneth Kieran, Minister of Recreation and Conservation of the Province of British Columbia, dated June 25, 1969:

"Nine immature Peregrine Falcons were successfully collected from nests in the Queen Charlotte Islands by Fish and Wildlife Branch personnel this month as part of a new program designed to protect this rare species and to provide research information. Collection of birds by government personnel, rather than by the public, succeeded in reducing illegal activity in the area over that in recent years. In addition, the nestling falcons were systematically removed to provide information on the effects of a known removal rate on long-term population trends, said Dr. J. Hatter, Director. *They were immediately flown to Vancouver and picked up by falconers who had previously paid a $200.00 collection fee.* (Italics mine).

A survey of falcon nesting sites in a sample area of the Queen Charlottes revealed about the same number of breeding pairs as in 1965 and 1968. The average number of young per nest this year was 2.25, down slightly from the 1965-68 average of 2.75. However, due to the time involved in collecting birds, fewer nests were examined this year."

I have in hand a copy of "Hawk Chalk" (Volume VIII, No. 2, August, 1969), a periodical which is an official publication of the North American Falconry Association (NAFA) and the articles in this particular issue dramatize implicitly the direction from which the winds are blowing on the remnant Peregrine nesting sites. This particular issue of Hawk Chalk reads like an obituary to falconry. On the one hand there is immense concern about the effects of chlorinated hydrocarbon biocides on the future of the Peregrine and about the declining populations of raptors in general and on the other hand, a powerful plea by the president of NAFA, Mr. H. M. Webster, to members to oppose very strongly a recent bill before the United States House of Representatives (HR 11363) that would "prevent the importation of endangered species of wildlife into the United States; prevent the interstate shipment of wildlife taken contrary to state law; and for other purposes." Mr. Webster states that this bill "is probably the most restricting thing that has ever been brought to my attention." He asks that members put in their requests to their Congressman and to quote further says that:

> "You will all remember that the Peregrine was recently placed on the endangered species list, well, here it where it will go for there are no recognized subspecies set forth as exceptions. This bill permits the Secretary of the Interior to act as judge as to what species of animal or wildlife is to be classified as endangered despite the provincial, territorial or national law of the country that originates the shipment. For example, it will be impossible to receive Peale's Peregrine (the subspecies along the British Columbia coast) even under permit from British Columbia or anywhere else in the world for that matter. This would mean Canada, Mexico or elsewhere despite permits issued for the shipment of the birds. The Secretary of the Interior *may* review the endangered list every five years (if we holler sufficiently loud). You may be arrested without warrant, you may be searched without warrant and any of your birds taken. This will stop any of our falconers from travelling to Canada to hunt or to Mexico to hawk." — "If everyone sits quiet and tight, falconry as we know it is quickly approaching a tragic end." —

It is a paradox that the very same issue of Hawk Chalk reports that a biologist, Dr. James H. Enderson, just finished checking all known Peregrine eyries in the Rocky Mountain Region from Mexico to southern Alberta; he estimated that no more than 10 birds fledged in the entire area (elsewhere in the issue the number is reported as "two sets of young hatched".)

Hawk Chalk also carried a long letter from the retiring Canadian Director of NAFA, Mr. Frank Beebe, who states:

> "I have never been of the conviction that the Peregrine is going extinct, but even if it is and does there are still other species and perhaps I have done a little more than most others to "save" it; more certainly, than those who are most critical of my making use of the species."

Mr. Beebe states further that he will no longer "cooperate" with the B.C. government to make his data available, nor publish any material in scientific journals, nor turn the carcass of dead birds in for analysis. He states further "so far as officials are concerned none of my birds ever die or are lost; so far as other falconers are concerned again the same thing exactly." He states that he is against, and he argues hard for *excluding* persons who breed hawks in captivity (for the use of falconers, etc.) from the board of directors of NAFA. He ends his letter by stating that "from here on I shall write only about some aspects of *falconry*, not about people, or pesticides, or the biology of wild raptors, or theories or facts about domestic reproduction." Presumably, to be a good falconer you just have to capture your falcons from the wild and how many you get, where you get them and what you do with them does not concern people other than falconers.

The Meetings at Cornell, organized by Dr. Cade, concluded with a statement by Dr. Cade saying that the best way to preserve the Peregrine is to declare the entire North American Peregrine population to be endangered. "The moral force of such a declaration by Canada, Mexico and the United States would place the state and provincial governments which have legal jurisdiction over the Peregrines, under a strong constraint to tighten their local regulations on man's behavior in relation to this highly esteemed bird."

THEODORE MOSQUIN, December, 1969

A CONTRIBUTION TO THE BIOLOGY OF THE GRAY JAY (*PERISOREUS CANADENSIS*)

Russell J. Rutter
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Although the Gray Jay has been consistently mentioned by travellers in the northern wilderness since the earliest times, and is today one of the first birds to be noticed by the myriads of urban dwellers who now invade its haunts in search of summer recreation, surprisingly little is known about its life history. This is partly because of its wilderness habitat and the fact that its reproductive cycle coincides with a season when bush travel is difficult or impossible. But I think one of the main reasons is that it was long ago "tagged" with certain characteristics by somewhat fanciful observers, and their reports have been repeated in bird-book after bird-book for generations. Everybody knows about the Whiskey Jack. A good example of this is the first sentence under "Behavior" in Bent's famous *Life Histories* (1946): "The most striking and characteristic traits of the Canada Jay are its tameness or boldness, one could almost say its stupidity, and its thieving propensities."

I have had unusual opportunities to observe this bird during the past ten years in Algonquin Provincial Park, Ontario, and more recently have benefitted from the cooperation of Dan Strickland, a graduate student at the University of Montreal, who has written his Master's thesis based on two years' study of Gray Jays in Parc de la Vérondrye, Quebec. Acknowledgment is made here of his generosity in allowing me the free use of his notes in preparing this paper. While it makes no pretense of being comprehensive, it will deal with some information that I believe to be original, and it is frankly suggestive of possibilities for further studies.

What Do We Know?

In 1899 Oscar Bird Warren contributed an article to *The Auk* under the title "A Chapter in the Life of the Canada Jay," and I have not seen a more complete account of the nesting behavior of the species. Since Warren's contribution there have been many additions to the literature, but each has dealt with some special feature of life history. Bock (1961), Dow (1965), and Stirling (1968) have written on some aspects of feeding habits; Lawrence (1957) and Devitt (1961) have reported instances of displacement singing; Campbell (1965) and Roberts (1966) have published accounts of migratory movements; Lawrence (1968) has reported flycatching and storing of potential nest-building material, and Allen (1965) has described how food is sometimes carried in the feet. Informative as these items are, they have told us little about the Gray Jay's daily life, and we must rely on early discursive accounts for information on its general habits.

We have been told by many writers that it is all but omnivorous, but we really know little about its natural food, particularly its seasonal variation, or how it sustains itself through long subarctic winters where it is not in contact

with man. Its fascinating social relationships, permanent pair bonds, and strict territorial organization have been given little or no attention. I have been unable to find in the literature a single reference to its territorial habits, surely one of its most interesting characterisics.

As with all animals that tolerate only a limited population on permanent territories, a great deal of study is required on population dynamics. For example: In one territory in Algonquin Park only five birds were required to maintain a pair through five years, indicating a loss of three during that period. On another territory only one bird disappeared in five years. With a survival of only 50% of the potential 30 young that could have been hatched on these two territories in five years, the question of what happens to the extra birds in a country already supporting a maximum jay population is an interesting one.

References in the literature to seasonal movements have ranged from generalities such as, "Winters at lower elevations in breeding range" (Bailey and Niedrach, 1965) to documented reports of observed migrations (Campbell, 1965; Roberts, 1966), but the origin and age-structure of these wandering birds have not been investigated. Studies of marked birds show that each territory, of approximately one-half a square mile, is occupied throughout the year by one pair, and it is reasonable to guess that birds dispersed over the country outside the normal range are surplus young unable to find a place in the territorial pattern. The difficulty of proving this is increased by the fact that after the postjuvenal molt, which is completed before September, birds of the year are indistinguishable in the field from adults. Complicating the situation are such observations as that of Roberts (op. cit.) who, at Whitefish Point, Michigan, saw large numbers of Gray Jays concentrated on the point, along with other migrants on 21 May 1966. This seems to give strength to the theory that such birds are displaced young of the preceding year, as all established Gray Jays would at that date be caring for young. But where did they come from and where were they going? No suggestion of an influx of birds at any season has been noted in more recent studies.

THE NECESSITY OF COLOR-BANDS AND A TECHNIQUE DESCRIBED

From 1959 to 1963, as a part of the Park Naturalist's banding program in Algonquin Park, I banded 64 Gray Jays with the standard aluminum bands issued by Canadian Wildlife Service. It was apparent from the results that these bands were of little use for individual field recognition, as most of the banded birds could not be trapped a second time, at least for a year or more. It was equally apparent that, as J. P. Scott (1967) has so neatly phrased it, "Without knowing the identity of individuals and the social relationships between them, it is impossible to interpret their behavior in any but hypothetical ways."

In the fall of 1960 I had experimentally color-banded five Gray Jays at widely separated points in Algonquin Park, but this small project had not been followed up and few of the birds had been reported. In the winter of 1963-64 I maintained a feeding station at the Park Museum, and one of the five jays that were daily visitors was wearing an orange band that I had applied near the

Museum on 15 November 1960. This was further evidence of what I had long suspected, that these birds remained at or near the same place year after year. I had also noticed that almost always when more than two birds were together there were frequent agonistic encounters and I was curious about the cause of such behavior. So I decided to begin a long-term color-banding project, and as a beginning I marked the four unbanded birds visiting the feeder.

Within a few days of doing this the value of the technique was apparent. I learned that only two birds belonged at the Museum, and the other three were intruders from an adjoining territory, where one of them was also an intruder. On the Museum territory the three intruders were compatible among themselves but all were attacked by the resident pair. When they returned to their own territory, two of them resented the presence of the third. Situations of this kind are not uncommon among Gray Jays, and the term "third bird" has been used by Strickland and Rutter to describe a bird that attaches itself to an established pair and, although resented and harassed, remains with them for a period of time. In some cases a third bird is resented more by one of the pair than by the other, and it could be that this represents antagonism toward another of the same sex. It may remain for only a short time, but the one mentioned in the preceding paragraph persisted for 15 months, including one nesting season and a part of another. This third bird associated with the male without conflict while the female was incubating but was not seen while the young were in the nest. It was always attacked by the female when she was off the nest, and it did not appear again after the second nesting. There is evidence that third birds are not young of the pairs with which they associate. In the spring of 1968 Strickland banded three young, and in the fall their parents were accompanied by a third bird that was not one of the banded young. Brewster (1937) describes an instance of this behavior that he observed in Maine.

A brief explanation of the marking technique used in Algonquin Park is given here. A single-cell Potter trap is used to capture the birds, and the first capture presents no problem. Each bird is fitted with a standard aluminum band on the right leg and either a color-band or bands on the left leg or a color-band over the aluminum band on the right leg. Using six colors – green, blue, yellow, orange, red, and white – 48 birds may be marked by this simple method without placing more than three bands on any bird. By fitting the standard band on the left leg the system may be duplicated in reverse, and other patterns may be devised as the need arises. The keeping of records is facilitated by referring to the banded birds in accordance with the position of the bands: GL for a single green band on the left leg; GO for a single green band over the standard on the right leg; GOWL for a green band over a white band on the left leg. In Algonquin Park, where the great number of human visitors may give valuable assistance by reporting banded birds, the above system encourages participation, as people are interested in birds with such names as YOWL, BOYL, BOWL, WOOL, and OOGL. I have no record of a Gray Jay removing a band or of the bands interfering in any way with its normal activities.

An unexpected and not immediately appreciated result from the banding of the birds at the Museum feeder was the establishment of the sex of the local pair when they were seen in copulation on 30 March. Their nest had already been discovered at that time, but without knowing which was male and which female meaningful observations on their individual roles during nesting would have been impossible. Just how important this observation was may be understood from the fact that among 16 nesting pairs that Strickland and I have watched, this is the only witnessed copulation, and Blomgren (1964) reports only one from the many nests of *P. infaustus* that he had worked on in Sweden over many years. Differences in behavior between the male and female at the nest are sufficiently stereotyped that, once a marked pair has been watched, it is usually possible to make the distinction from behavior alone, but in the case of unmarked birds there are always areas of uncertainty even after long familiarity.

Species in which sex cannot be differentiated in life present many problems, not the least of which is the incorporation into the literature of uncertain observations. Grinnell (1900a) wrote of the behavior of a pair of Gray Jays that he was watching near their nest, "They followed each other about playfully, uttering low, conversational notes. The male would try to approach the female, vibrating his wings and striking various coquettish attitudes . . ."; and Lawrence (1968) describes a feeding situation, "Hopping on the ground with a piece of food in the bill, one of a pair of Gray Jays, upon being pursued by its mate in an effort to take the food away, went into an interesting display. The bird ran out of the way of its pursuer with all the contour feathers fully erected and then crouched with wings held stiffly out from its flanks, tips vibrating. At the sight of this display the mate immediately stopped the pursuit". Grinnell was watching a not uncommon performance of a pair in the vicinity of the nest, but it is always the female that strikes the "coquettish attitudes." Lawrence describes a situation where an intruder, well loaded with stolen food, decides to stand its ground, and by an elaborate threat display, temporarily halts the attack of the bird that is defending the territory. A paired bird would not try to take food forcibly from its mate.

But these are easy mistakes to make. In his account of a study of Central American jays Alexander Skutch (1935) comments, "The difficulty of recognizing individuals is one of the chief handicaps which face the serious bird-watcher." And Blachard (*in* Nice, 1937), telling of an encouter between two female White-crowned Sparrows, wrote, "Had they not been banded, I should have thought I was watching a boundary dispute between two males." Even the birds have difficulty. Nice (op. cit.) says in describing the use of live birds as decoys for trapping members of the same species, "But this method is successful only with birds that know each other, for otherwise a Song Sparrow cannot tell the sex of one of its kind in the trap any more surely than a person can. . ."

TERRITORY

"Territory" as used in this paper is defined as the area occupied and defended by a pair of birds throughout the year. Although the nest is built

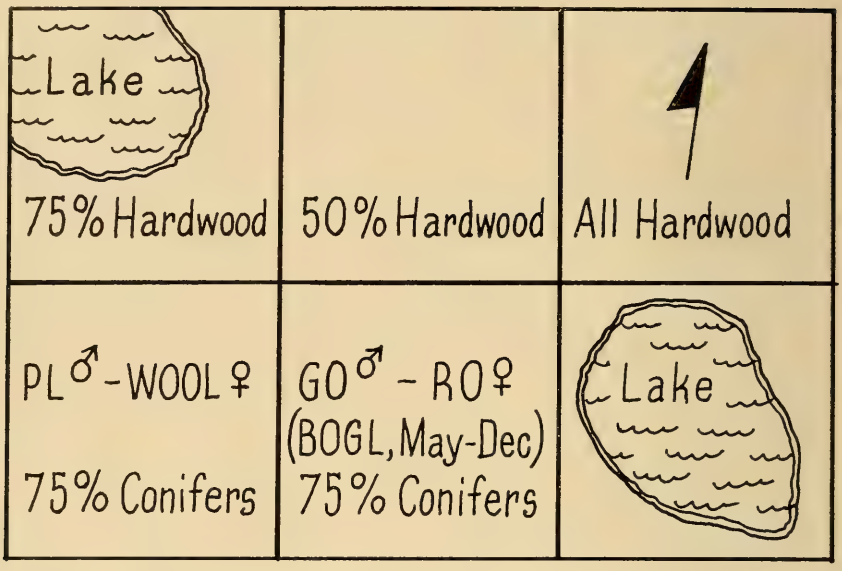

FIGURE 1. Territorial occupation by Gray Jays of 1½ square miles in Algonquin Park, 1968.

on this area there is no evidence of a nesting territory as such, and there is a wide tolerance of man and other animals in the nest vicinity. They may attack such potential predators as the Red Squirrel (*Tamiasciurus hudsonicus*) or the Blue Jay (*Cyanocitta cristata*) near the nest, but they may do this anywhere if there is a food source involved. I have several times seen a Red Squirrel unmolested within a few yards of a nest when one or both of the adults were present. The only defensive action that might appear to be concerned with nesting arises from a direct attack on the young, as when they are being handled for banding. If the young become vocal their distress calls seem to provoke a violent reaction in the adults, and they will literally fly in the face of the intruder with loud, clattering cries that might well deter a natural predator. They will react in the same way, however, to an attack on the young after they have left the nest area. A newly hatched young, which utters no sound, has been taken from the nest and photographed while being held in the hand without causing the adults any apparent concern. (Strickland, Pers. Comm.).

Consistent territorial defence for no obvious reason (e.g. food) is maintained only against other members of the species, and these are generally attacked on sight. Some parts of the territory are used much more than others, probably because of more favorable habitat, but the seldom used parts are vigorously defended if an occasion to do so arises. In the winter of 1968-69 GO and RO spent much time near their southern boundary and often trespassed deeply into the territory of BOGL and WO, who were usually near the southern boundary of their territory (Fig. 2), and thus did not notice the encroaching of the other pair. When I became aware of this situation I lured

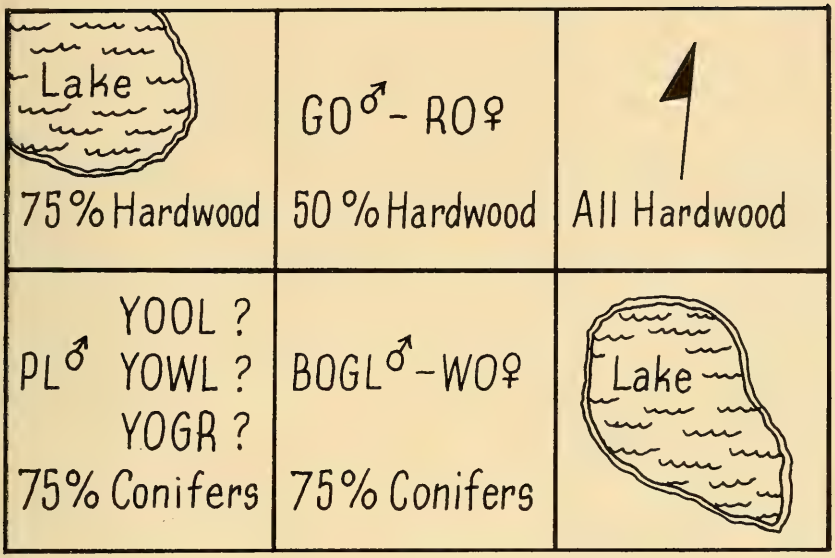

FIGURE 2. Territorial occupation by Gray Jays of the same area in 1969.

BOGL and WO northward by the use of food until we encountered GO and RO, when the latter were promptly attacked and driven back across the territorial line. Trespassing birds are aware that they are trespassing, and always give way before an attack by the rightful occupants.

In Algonquin Park, Ontario, and in La Vérondrye Park, Quebec, it has been found that the territory of each pair of Gray Jays approximates one quarter of a square mile, or 160 acres. Coniferous forest, particularly spruce, or a spruce-tamarac association, with trees of small to medium size is the preferred forest cover. Pure hardwood stands are utilized for foraging, but there is no record of a defended territory that was not at least 50% coniferous. In La Vérondrye Park, where there is continuous coniferous cover over large areas, territories tend to be more often contiguous than in Algonquin Park, where the coniferous stands are frequently broken by hills of Precambrian rock supporting maples and other hardwoods.

The only recorded case of an established pair being displaced by another occurred in Algonquin Park between 1968 and 1969. The male GO, mated successively with GL and RO, had occupied the Museum territory since 1964. In the spring of 1968 BOGL appeared as a third bird with GO and RO and remained on the territory in spite of frequent harassment by GO. In October, 1968, a fourth bird appeared, and eventually, as WO, became the mate of BOGL. In December all four birds were using the territory, but GO and RO were seen only rarely, and by the end of the year it was evident that BOGL and WO were the resident pair. Field work during the winter disclosed that GO and RO were occupying the next territory to the north. The diagrammatic sketches, Figs. 1 and 2, are an attempt to illustrate this territorial change.

Competition for territory might be expected on this variable terrain, and it has not yet been shown that such displacements occur where suitable habitat is more continuous. Further evidence of possible intensive territorial competition might be deduced from the situation on the territory immediately west of that occupied by BOGL and WO. There the male PL, who had lost two females, had held the territory for at least six years. In the spring of 1969, however, there were four Gray Jays there, no two of which formed an unmistakable pair. Although PL was still the dominant bird, the resulting social disturbance was such that there was some uncertainty whether or not a nesting occurred.

Food and Storage

Because of its preoccupation with gathering and storing food and its quick recognition of man as a food source, the Gray Jay is not easily studied under completely "natural" conditions. Contrary to the popular idea, it does not instinctively expect man to provide food, but as man increases his use of its natural habitat the possibility of finding birds that have not learned to do so diminishes. On the other hand, the disadvantages of working with birds that have had their habits modified by the presence of man are partly offset by the advantages of being able to manipulate the birds by the use of a controlled food supply.

Outside of the commensal relationship that often exists between man and jay it is a retiring, inconspicuous bird, paying little attention to man and his activities and keeping its affairs to itself. But it learns fast, and once having identified man with food it does not forget. So strong is the food-storing instinct htat it may supersede, at least temporarily, not only nest-building, but incubation of the eggs and care of the young. The female of a pair that is accustomed to being fed by humans may be enticed to leave her incubation or brooding by offering her food, and I have discovered several nests by making use of this habit. The male, ordinarily avoiding the nest vicinity during incubation, will often come to pick up and carry off food placed at the base of the nest tree. At such times he ignores the nest completely.

Gray Jays have been seen storing food at all seasons, but it may be that storing is not a major activity during the warm months. It is not easy to obtain information on this because they are then occupied by caring for young and by passing through the annual molt, and they become quite inconspicuous. At any season, with exceptions noted below, it is not common to see them storing food except under artificial conditions. We conclude only by inference that they store natural food in the same way. There is a period in late summer and early fall when they become comparatively indifferent to food of human origin and spend much time foraging on the ground in grassy areas. Stomach analysis of birds taken then indicate that grasshoppers may form a considerable part of their diet. They have been seen collecting frozen chokecherries in late fall and apparently carrying them off for storage, and cherry pits have been found in stomach contents. But there are few records of them taking any kind of vegetable food under natural conditions. They do feed on dead animals, and

Gray Jay, showing bulging throat from food to be carried off and stored or fed to young.

in circumstances such as the wolf-deer association in Algonquin Park, a predator kill may become a major food supply while it lasts. Because of the uncertain occurrence of kills and the territorial habits of the birds this can hardly be considered as significant in relation to the general population. When they do have an opportunity to utilize this kind of natural food it is actively stored.

Their method of storing food is probably unique among North American birds. Anything intended for storage, whether a piece of meat or a collection of bread crumbs, is manipulated in the mouth into a roughly oval bolus impregnated and coated externally with a glutinous saliva that adheres to anything it touches. This bolus is pushed into a crevice in the bark of a tree, among the needles of a conifer, under a tuft of lichen, or in any similar place. It has the appearance of an object coated with shellac, but to what extent the saliva acts as a preservative is not known. Neither is it known how much of this food is recovered and eaten later, but there is no doubt in my mind that it is the deciding factor that enables the Gray Jay to occupy a restricted territory in northern regions throughout the year. Dow (1965) found that captive birds began to utilize stores within hours if they were deprived of other food.

An experiment carried out by Strickland showed that they may feed the young from stored food if bad weather interferes with the normal supply. For some time before the nesting cycle started and while nest building was in progress he kept one pair supplied with bread that had been colored by a water soluble dye. This was both eaten and stored, and the color showed conspicuously in the faeces of the adults. The dyed bread was discontinued at the start of incubation, but 40 days later, during a period of adverse weather, the color appeared in the faeces of the young, which were then 19 days old.

Storing is usually done on the birds' own territory, but intruders attracted to an adjacent territory by some exceptional food supply often store on the territory upon which they are intruding. It is unlikely that they remember where each bolus is stored. At any given time they must have thousands hidden within feeding range, and most of them would be discovered sooner or later in the course of normal searching.

In Algonquin Park in winter it is common for a pair to have a satellite Blue Jay that gets a good part of its living by stealing from their stores or directly from the source of supply. It is too wary to come close enough to take food offered by a human being, but it will watch a Gray Jay hiding a bolus and then try to find it. Sometimes when I have been searching for a pair with which I have temporarily lost contact, the Blue Jay has shown up first, and it may be that its more mobile and higher flying habits occasionally help the Gray Jays to find food. It also repels other Blue Jays that invade its "concession," so that its presence is not entirely without value. At least on their own territory, Gray Jays are dominant over their larger and stronger relative, but it is generally ignored except when near their nest or in direct contact with a food supply.

PREDATION

Gray Jays have been seen to attack the Red Squirrel (*Tamiasciurus hudsonicus*) and the Blue Jay in the vicinity of the nest, and they easily repel

Gray Jays. The bird on the block of suet is manipulating food into a bolus for storage. Note bands – yellow over orange on left leg = YOOL.

these potential predators when they are detected. In La Vérondrye Park a nestling was killed by a squirrel, but the events leading up to this action were not seen. The young in this nest were 20 days old and could have been in the process of leaving the nest, perhaps during temporary absence of the adults. They would be vulnerable to such an attack at that time (see account of nest-leaving under "Nesting"). A brood of three in Algonquin Park were destroyed, also on the day of leaving the nest, either by Ravens or a Marten (*Martes americana*) both of which were seen in the vicinity. When we consider that the natural habitat of the Gray Jay is also that of such predators as those mentioned, they seem to be remarkably free from predation.

There are many references in the literature to predation by the Gray Jay on the eggs or young of smaller birds, but this is mostly assumed from the bad reputation of the Corvidae, and there is not much documented evidence. They are often treated as predators by smaller birds, and are generally attacked on sight by such extroverted nest protectors as the Robin and the Barn Swallow.

NESTING

The average date for the start of incubation in this latitude is 20 March, with extreme dates recorded of 14 March and 8 April. About two weeks is spent in building the nest. On 4 March a nest in La Vérondrye Park was only a handful of twigs, anchored to horizontal branches by the silk from insect cocoons. On 13 March it looked like a finished structure, but incubation did not start until 19 March. A late nest in Algonquin Park was finished within one week. On 1 April it was also an untidy cluster of dead twigs, but on 3 April it seemed to be finished, and incubation started on 8 April. There was some evidence that this might have been a second nest, following an accident to the first. Any time after 1 March the birds may be seen breaking off dead twigs and carrying them about, or collecting feathers or shredded bark and storing them in the same manner as food, except that no saliva is used. The male seems to be more active in this pre-building behavior than the female, but it is uncertain whether or not he initiates the actual construction. To what extent this stored building material is used in the eventual nest is also uncertain. According to my records, once the building is well under way the female does the major part of the work, but Strickland has seen a male working on a nearly finished nest, even to the extent of shaping the nest cup with his body. As with many other birds, there is a period of several days between completion of the nest and the laying of the first egg.

Nests have been found in Ontario and Quebec in Black Spruce (*Picea mariana*), White Spruce (*Picea glauca*), and Balsam Fir (*Abies balsamea*), with Black Spruce predominating. A typical nest would be from eight to 14 feet above the ground on the south or southwest side of a Black Spruce and facing an opening of some kind, a beaver mealow, a brulé, or perhaps just a small space left by a falling tree. But there is always enough clearing to allow the late winter sun to reach the nest and to give the birds a free passage to come and go. In 1965 one nest in Algonquin Park was 40 feet up in a Balsam Fir — the exception that proves the rule. In some parts of the Northwest, where

Gray Jay on snow-covered nest. March, 1964.

coniferous trees are not readily available, nests have been found in shrubby willows (Bent, 1946).

If a nest is to be found without the intervention of good luck it must be done while it is being built. Except for an occasional furtive visit to feed the female, the male avoids the nest vicinity during incubation, and the female sits very closely from the first egg and it is almost impossible to flush her by ordinary means. When there was a nest 300 yards from the Park Museum in Algonquin Park, the male spent most of his time on the Museum grounds, and I often left him there while I went to inspect the nest. He would still be there, quite unconcerned, when I returned. In order to inspect the contents of a nest it has been my practice to extend my hand slowly toward the sitting bird. When it was within a few inches she would get off, barely moving out of the way, and returning at once when I moved away a few feet. I have worked for an hour erecting an observation platform, using saw, hammer, and nails, beside a nest that was ten feet from the ground, without disturbing the sitting bird or bringing the male to the scene. Lawrence (1947) tells of trying to ascertain the contents of a nest that was eight feet from the ground but from which the female "refused to budge" even when one of the observers walked up to the tree and waved his hat in front of her.

The female does all the incubating and it is difficult to find the nest unoccupied. The male does feed the female on the nest, but this is an unscheduled and irregular activity and is seldom seen. The full complement of eggs in all nests that have been found in Algonquin Park and in La Vérondrye Park has been three, but Warren (1899) found four in Michigan, Brandt (1943) found four in Alaska, and Bradbury (1918) reported two nests with two eggs each in Colorado.

The average incubation period, from first egg to first young, is 20 days. For several days after the young hatch there is little change in the nest attentiveness of the female, but the male brings food at irregular intervals, varying from five minutes to two hours. When he arrives at the nest the female stands up, takes food from his bill and they both feed the young. At this stage they appear to swallow all the faeces, and this continues to some extent as long as the young are in the nest, but in the later stages they often carry away a fecal sac.

The female does a great deal of poking about with her bill in the nest, and this activity increases with the growth of the young. Some of this consists of a violent jabbing in the nest lining while the bird's body is raised to an almost vertical position. This unexplained habit has been observed in other passerines (Jehl, 1968), and has been called "airing the bed," from the theory that it may be concerned with ventilation or with the removal of uncomfortable objects from the lining.

As early as the third or fourth day after hatching, the female begins to make short foraging flights with the male, and her absences gradually lengthen until about the tenth day. After that the adults generally go and come together and there is little brooding of the young except at night or during adverse weather.

The eyes of the young open between the 10th and 12th day, and at the same time they first become vocal, uttering a chattering chorus when the

adults come with food. I have described this in my notes as a "clamorous murmur." All growth accelerates at this time, and wing and tail feathers erupt rapidly. The bills of the young, which are at first pinkish, become for a time almost pure white, and may be seen readily from a distance of 30 feet. They remain in the nest from 17 to 20 days, but whether the variation can be correlated with external factors remains to be verified. In my own records they left earlier in calm, mild weather, and later when it was cool and wet.

Compared with most passerine birds, feedings are widely spaced, and it is not unusual for the young to be unattended for almost two hours. The longest timed interval in my notes was one hour and 50 minutes, but intervals of more than one hour are common. During their last week in the nest the young are fed about 12 times in 12 hours by each parent, or a total of 24 feedings a day. The number of feedings, however, cannot be taken as a measure of the amount of food. Jays carry food to the young in their throats, and often an adult comes to the nest with the feathers of the throat partly standing on end and sometimes the bill partly open from the bulging load within.

What the food consists of is not known. Watching the feeding at close range it appears to be a dark, glutinous mass heavily impregnated with saliva. I think there is little doubt that it is mostly insects. They have been watched catching small moths and working over rotting logs and trees that have been recently felled. In such places they might find hibernating carpenter ants or wood-boring larvae. Two or three times I have seen them give the young such artificial food as bread when I have been feeding them near the nest, but this is not usual and has always been when the nestlings were close to fledging.

Because it demonstrates some unusual behavior, a brief resumé of the vacating of a nest by the young will be given here. This nest was only 52 inches above the ground in a Black Spruce, situated on a sparsely forested plain of glacial sand where the ground cover was chiefly of blueberry (*Vaccinium* sp.), Sweet Fern (*Comptonia peregrina*), and Sheep Laurel (*Kalmia angustifolia*). I had checked the nest at 16:40 on 3 May and at that time the three young, then 16 days old, had just been fed and were quiet. I did not see the nest on 4 May until 17.25, and when I arrived one adult was perched on the rim but was not attending the young and left one minute later. An inspection showed that one young had already gone, and the two remaining were very alert and were calling with a soft "chep" note that I had not heard before. I retired to my usual watching place 30 feet from the nest and waited. At 17:32 one young climbed out and fluttered to the ground, making off immediately in the direction taken by the adult and proceeding rapidly through the rough ground cover by vigorous hopping and flapping, accompanied by continuous "chepping" calls. In about 25 yards it encountered the trunk of a dead poplar that sloped upward at a 30 degree angle from the ground and was lodged in a windfall of small dead trees. It ascended this by a series of fluttering hops, each one accompanied by an emphatic "chep". Three feet from the ground this trunk rested against a horizontal one, and the nestling turned off there and went along the horizontal trunk to where it lay against a standing

tree. There it assumed a roosting position against the upright tree and from there it called intermittently, either a single "chep" or a fairly loud, two-syllable call that I wrote down as "Queeu-queerk." I approached to within three feet of this bird and at that point one of the adults came down and fed it. This was at 17:37. As the adult flew away, the young, its hunger apparently unsatisfied, started off in the same direction, working its way along the log. After about six feet it fell off, but continued on the ground until it disappeared beneath a thicket of spruce. In a moment I could see it working its way upward in one of these, hopping from one limb to another, and I turned my attention to the young still in the nest.

At 17:45 it had left the nest and was moving about in the tree, twice getting into and out of the nest. It was also giving the two calls already described. At 17:45 both adults came to the nest with food and both fed the young that was perched on a nearby branch. After they had gone, the young one carried out a complete preening operation on itself, then put its head over its left shoulder and partly hidden among its scapular feathers and appeared to sleep. At 18:20 an adult arrived with food but was unable, after repeated efforts, to arouse the young. The adult then went to the nest, but finding nothing there it returned to the young, which this time raised its head long enough to take food and at once returned to its sleeping position.

No adult had visited the other young since 17:37, or for 43 minutes, but at 18:21 it was being fed in the spruce tree by the other adult. It was then settled close against the trunk but was only about one foot above the ground. No more feeding was seen, but at 18:27 an adult was at the nest fussing with the lining as if it were still occupied, although the sleeping young was just over a foot away. The adult settled on the nest as though brooding for two minutes and then flew off. All was quiet when I left at 18:38.

I was unable to visit this nest again until 14:45 on 6 May. There were no birds at the nest site when I arrived, but in a few minutes both adults appeared and flew past the nest into a close growth of spruce 50 yards to the northeast. I could not see what happened there, but a search of the spruces disclosed two young, both in the same tree, one four feet above the ground and the other eight feet. They sat tightly against the trunk and did not give any food calls, but occasionally stood up to stretch or defecate. At 15:20 both adults came, but only one seemed to have food and this was given to the highest young. These were unmarked birds and I was unable to separate male from female in these circumstances. They left without seeming to notice me, and did not come again until 16:30, when again one of them fed the same young bird. When they left this time the young that had just been fed attempted to follow them, but made a "crash landing" after about 100 feet. However, it quickly made its way to the base of another spruce and was soon ascending it branch by branch. I was unable to wait longer and did not see these birds again.

Subsequent observations on other nests suggest that this was fairly typical post-nestling behavior. Leaving the nest when they are capable of flying only a few yards they move about by making short flights and working their way up-

ward to roosts in thickly foliaged conifers, where they may be better protected against predation than they would be in the nest at that stage of development. It is not known how long parental feeding continues, but on 22 May of the same year I found a group of three young, fully feathered and capable of sustained flight, still spending most of the time perched close to the trunks of conifers and apparently still depending on the adults for food, although they were making tentative efforts to feed themselves. It is very difficult to keep in touch with these family groups, for they are constantly on the move and soon have the additional concealment of summer foliage.

Although it is essentially a bird of the wilderness, the Gray Jay is quick to take advantage of man-made sources of food, and that this adaptability extends also to its choice of nest-building material is illustrated by the following comparison of the composition of two nests in Algonquin Park. No. 1 was situated one mile from the highway that passes through the park; No. 2 was 300 yards from the Park Museum, where there is much year-round human activity.

NEST NO. 1

Base of dry spruce, tamarac, and poplar twigs (up to 14 inches long), supporting and partly surrounding the nest proper, which was largely composed of shredded cedar bark with an intermixture of plant fibres and shaped into a cup by the body of the bird during the building process. This cup was deeply lined with feathers of Ruffed Grouse (*Bonasa umbellus*) and Spruce Grouse (*Canachites canadensis*), a small amount of moose hair, and one small piece of facial tissue. Dimensions: Diameter at base, 12 inches; from lower edge of base to rim of cup, five inches; diameter of cup, three inches; depth of cup, three and one-half inches. Weight of all material, 208.4 grams.

NEST NO. 2

Overall construction similar to No. 1, but the cedar bark surrounding the cup was reinforced by one piece of light string seven inches long, one piece of heavy cord three inches long, one piece of binder twine 13 inches long, a considerable amount of facial tissue, and several wads of surgical cotton. An interesting addition to the lining of this nest was the scapular feathers and several body feathers of a Saw-whet Owl (*Aegolius acadicus*). Present in all Gray Jay nests are many cocoons of spiders and lepidopterous insects. These help to bind the material together and anchor the base of dead twigs to the branches on which it rests.

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LIGHTNING FIRES IN SASKATCHEWAN GRASSLAND

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Introduction

Have lightning fires been important in the ecology of native grasslands? The question has long been argued, a sure sign that substantial evidence is scarce. This report documents the occurrence of lightning fires in southwestern Saskatchewan grassland in 1967.

Making a case for early man as a congenital arsonist, Stewart (1956, p, 128) stated: "I have found no evidence that lightning ignited (the) vegetation on the plains and prairies at times and places to cause widespread grass fires". He called attention to the similar opinions of Plummer (1912): "I have been able to discover no authentic record of any grass fire ever being ignited by lightning", of Gleason (1913) who wrote that he could find "no record of a prairie fire produced by lightning", and of Braun-Blanquet (1932) who stated that fire "contrary to the opinion of some American investigators" is to be classed among the anthropogenous factors.

Stewart's view was contradicted by Malin (1956, p. 350) who, however, adduced only two references to lightning fires in grassland, both drawn from a 1911 Kansas newspaper! Noting the deficiency of evidence, Tukey (1956, p. 949) observed that "the collection and quantitative study of many more such examples might teach us about the frequency of lightning-induced grass fires . . . Then we might be able to make much better judgements of the importance of Indian fires in the North American grassland".

The importance of lightning as a phenomenon affecting vegetation has recently been assessed by Komarek (1966), who referred to a number of eye-witness accounts of prairie lightning fires on the plains of the western U.S.A., particularly in grassland districts of the National Forests. Raby (1966) assembled historical information that implicates lightning as at least one cause of the fires that plagued western Canada in early settlement days. He presented a letter by John Macoun, Naturalist with the Geological Survey of Canada, from which the following quotation (p. 99) is taken: "I may say that last season and in that year of 1893 fires were caused by lightning setting fire to the grass. In one thunder-storm last summer three fires were started at Crane Lake by lightning striking the prairie." Crane Lake is in southwestern Saskatchewan.

Saskatchewan Lightning Fires

In September of 1967 the radio carried reports of lightning fires in southwestern Saskatchewan grasslands. From the Royal Canadian Mounted Police at Swift Current I obtained the names of ranchers reputed to have seen fires started on their rangelands during thunder-storms, and they in turn referred me to additional observers. Information obtained by correspondence with thirteen men in the general area shown in Figure 1 is sumarized in Table 1. There can be little doubt that these reports are authentic, as corroborative

evidence was also collected from the RCMP (who frequently are involved in fighting the fires) as well as from soil surveyors and meteorologists familiar with the southwestern part of the province.

In the spring of 1968 I visited several of the burned areas near the International boundary south of Swift Current and interviewed two ranchers who had witnessed lightning fires in the previous fall. They were astonished to hear that the occurrence of lightning-ignited prairie fires had been questioned, for this threat to their grazing resource is recurrent and most dangerous in years when a moist spring with lush growth is followed by summer drought. So serious is the problem that in many districts the ranchers have co-operatively organized fire-spotting and fire-fighting systems to detect and contain fires set by lightning.

Although fires were fairly extensive in southwest Saskatchewan in 1967, it is not possible to estimate the percentage of open rangeland burned. Nor is there much information on the frequency of lightning fire years such as 1967, although respondents mentioned 1937, 1958, 1961 and 1966. On this slim evidence, perhaps one year in six has the combination of grass cover fuel and "dry storm" weather conducive to ignition of grasslands by lightning in southwest Saskatchewan.

Fire Effects

Two lightning-fired areas in Ranges 7 and 8 of Township 1, west of the 3rd Meridian, were examined on May 25, 1968. The grasslands belong to the *Stipa-Bouteloua-Agropyron* faciation of the Mixed Prairie Association according to Coupland (1961). The burns were estimated to be twelve square miles and one square mile in size. East and west boundaries were clearly defined, as the fires had run southward from the points of ignition before brisk winds. The contrast between the clean-burn ground and the unburned ground with its carry-over of dead foliage and litter was striking. Because of the earliness of the season it was not possible to make a detailed floristic comparison of burned and adjacent unburned areas but the following effects of the fires were obvious.

On dry stony hilltops and hillsides where vegetation had been sparse, the fire had burned off the grass-herb cover and exposed a ground stratum of *Selaginella densa* apparently unharmed and protecting the slopes from erosion. The chief sprouting species in the clubmoss mat was prairie wool, *Carex eleocharis*, accompanied by sprigs of unidentified grasses. *Pulsatilla ludoviciana*, prairie crocus, was the prominent resprouting herb. Sagebrush, *Artemisia cana*, had been practically eliminated from these sites; not only had the woody stems been consumed but in some places the fire had eaten into the tap-roots several inches below the soil surface, the former position of each bush being marked by a circular black patch with a small hole or a charcoal stub in the center.

On moister sites with gentler slopes where the adjacent grassland suggested that pre-burn vegetation had been dense, the fire was more destructive. In some places the *Selaginella* mat had been completely removed to mineral soil, destroying as well the living crowns of the grasses. *Agropyron dasystachyum* in particular had suffered severely, its crowns burned out over areas up to 10

Figure 1. Solid squares mark reported lightning fires in grasslands of southern Saskatchewan.

feet in diameter. Substantial patches of *Rosa acicularis* had apparently been killed too, for there were no signs of resprouting among the charred stems.

DISCUSSION

The above observations are consistent with many reports in the literature showing that fire is relatively more destructive of woody perennials than of grasses and herbs. Fire clearly favours the expansion of grasslands at the expense of shrubs and of trees. But although there is general acceptance of the idea that fire, from whatever cause, is a factor in grassland ecology, its importance has been difficult to assess.

TABLE 1. — Observers' descriptions of lightning fires, southwestern Saskatchewan

Observer and address	Date fire	Time	Location (section, township and range)	Topographic position of lightning strike	Remarks	
Loewen, Wm. Mankota	16 July/67	4:30 pm	Sec. 4, Tp2, Rg8 W3rd	Hay flat	Lightning struck a bale of hay and ignited it.	
Loewen, Chas Mankota	2 Sept/67	11:00 am	Tp2, Rg7, W3rd	Coulee	Lightning ignited brush, and fire burned 12 sq. miles.	3 other fires; in Rg9, Tp2 or 3; Rg4 or 5, Tp1 or 2; Rg7 just across international boundary.
Eklund, C. Glentworth	14 Aug/67	6:00 pm	SW1/4 4-4-7-W3	Coulee bottom	Fire burned about 5 acres.	
	14 Aug/67		SW1/4 5-4-6-W3		Fire from same storm as above.	
Lloyd, R. Glentworth	2 Sept/67	9:30 am	NW1/4 11-3-6-W3	Valley side long slope	Fire started in grass.	5 fires this day, one of them burning 18 sections.
Anderson, C. L. Fir Mountain	2 Sept/67	12:45 pm	NE1/4 16-1-5-W3	Hilltop, NE side	Fire started in grass 8-10″ tall and burned out of control for 5 1/2 hrs, travelling at speeds up to 15 mph.	Lightning fires very common in the area, 13 on this day.
	2 Sept/67	2:30 pm	NE1/4 14-1-5-W3	Low area among hills		Townships 1 and 2 along the U.S.A. border seem to be the worst for lightning fires.

TABLE 1. — (*Continued*)

Observer and address	Date fire	Time	Location (section, township and range)	Topographic position of lightning strike	Remarks	
Gaff, L. A. Battle Creek	Late Aug.-Early Sept/67		Tp6 & 7, Rg 30 W3rd	Side slope	One lightning bolt pronged out and started 3 fires about 7 miles apart.	This part of the country gets about 6 times as many lightning fires as the other parts of Sask.
Brost, D. Oxarat	4 Aug/66	2:30 pm	E1/2 14-7-27-W3	High ground	Burned about 2 acres then put out by shower.	
	July/61	5:00 pm	W1/2 17-7-27-W3	Level ground near small alke	Burned about 10 acres; put out by fire fighters.	
Smith, C. W. Reliance	10-15 Sept/67	7:00 pm	Tp3, Rg9, W3	Steep side hill covered with brush	Fire controlled by 9:30 pm when wind dropped.	3 fires within 2 miles burned 50-100 acres each.
	Early Sept/67	4:30 pm	Sec. 10-4-6-W3	Top of small knoll, and second fire on flat prairie	Burned less than 10 acres; put out by rain.	Every time the lightning struck it started a fire and there were 4 burning in a NW-SE line.
	20 Sept/67	am & pm	Tp3, Rg9, W3	All kinds of terrain	Many fires this day in south Sask. and adjacent Montana, 6 fires in a 30-mile radius.	

TABLE 1. — (*Continued*)

Observer and address	Date fire	Time	Location (section, township and range)	Topographic position of lightning strike	Remarks	
Dixon, B. Val Marie	2 Sept/67	10:30 am	NE1/4 24-2-11-W3	Upper east hill slope	Lightning hit and dust billowed up, rain extinguished fire.	Several other fires attributed to lightning on the same day, one that started in the morning burned 3-4 sections.
Reid, N. A. Val Marie	9 Sept/67	11:00 am	Sec. 36-4-12-W3		Lightning strike raised dust and when it cleared the ground was on fire.	2 other lightning fires about a mile to the east and 2 miles to the north.
Grubel, A. Gull Lake	2 Sept/67	10:45 am	SW 29-13-17-W3	Top of dry rocky hill, 1/2 mile south of lake		6 fires started by lightning in 75 mile area.
	21 July/67	1:00 pm	NE 24-13-19-W3	Edge dry creek bed in heavy buck brush		
Sweeting, P. D. Gull Lake	18 July/67	4:00 pm	NE 24-13-19-W3	Flat hay area close to creek bed		
Watson, Wm. Abbey	July /37	3:30 pm	NE 28-20-22-W3	Low ridge	Dry thunder-storm passed and 2 fires started.	
	2 Sept/67	10:00 am	SE 24-20-23-W3	Hilltop		Many fires started by this storm.
	Aug/58	4:00 pm	SE 21-20-22-W3	Haystack		2 other fires started by this storm.

Borchert (1950) placed fire as simply one of a number of factors operating in North American grasslands "under the master hand of climate". Others, unwilling to accept the implied concepts of grassland climates and climax grasslands, have proposed that fire plays a fundamental role in maintaining grassland against the invasion of woody plants (Wells 1965). In the extreme it has been proposed that *all* grasslands are fire disturbance types (Sauer 1950). The view that some grasslands owe their existence almost entirely to fire while others do not (Dix 1964) seems reasonable in the light of present limited knowledge.

The key questions concern frequency and extent of fires in grassland regions. In almost any year grasslands *could* burn; the fuel is there, usually in a dry state after midsummer. Whether or not they do burn depends on the two chief agents of ignition; man and lightning. The former we know fired the grasslands regularly in historic times (Bird 1961, Raby 1966). Did the latter operate with similar effectiveness in prehistoric times, perhaps over millions of years? The problem is important, for if lightning fires were intimate environmental events during the evolution of grassland ecosystems, then fire or alternate techniques that mimic its effects may be essential tools for the management of rangelands today (see the recent review by Daubenmire, 1968).

Although historic and prehistoric times are difficult to decipher, new methods such as analysis of thermally-altered carbon in soils, in lake sediments and organic deposits may produce helpful clues in the future. The subject will also be clarified by contemporary studies of grassland meteorology, and by experimental ecology that compares control-burned with unburned grasslands.

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SEX AND AGE VARIATION IN RED SQUIRREL SKULLS FROM MISSOULA COUNTY, MONTANA[1]

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INTRODUCTION

RED SQUIRREL (*Tamiasciurus hudsonicus*) taxonomy is based primarily upon coat color but some work has been done on cranial variations among the different subspecies (Allen 1898; Hatt 1929; Durrant 1952; Hall and Kelson 1959; Findley 1961). Basic data on sex and age variation in red squirrel skulls are limited. Layne (1954) found that males exceeded females in most but not all cranial dimensions, and that growth of the skull was essentially complete by 20 weeks of age. Findley (1961) found some cranial differences associated with age and body size.

This study was conducted to determine the nature and extent of variation in red squirrel skulls associated with sex and age.

MATERIAL AND METHODS

The skulls used in this study came from Montana State University Zoology Museum, Missoula (36 skulls), and Section of Upland Ecology, U.S. Fish and Wildlife Service, Missoula, Montana (72 skulls). All skulls of *Tamiasciurus hudsonicus richardsoni* were collected in Missoula County, western Montana.

The following cranial measurements (with abbreviations used in the tables) were taken to the nearest 0.1 mm with calipers:

Occipital-nasal length (Oc-nl lgth) as described by Layne (1954).
Length of nasals (Lgth nsls) as described by Howell (1918).
Zygomatic breadth (Zygmt brdth) as described by Layne (1954).

[1]Contribution of the Department of Wildlife Ecology, University of Wisconsin, Madison.

Interorbital breadth (Iorbt brdth) as described by Howell (1918).
Postorbital breadth (Porbt brdth) as described by Howell (1918).
Palatal length (Pltl lgth) was taken from the proximal surface of the base of the incisors to the posterior-most point of the palatine bone.
Palatal width at M1 (Plt wd @ M1) was taken across the palatine bone at the alveoli of M1.
Tooth row length (Tth rw lgth) as described by Layne (1954).
Breadth of rostrum (Brdth rstrm) was taken across the rostrum just anterior to the swellings associated with the incisors.
Mandible length (Mndbl lgth) as described by Layne (1954).

Five age groups were recognized based upon maxillary tooth eruption, replacement, and wear:

Stage I: M1, M2, and/or M3 not fully erupted; P4 lacteal.
Stage II: Permanent P4 replacing lacteal P4 but not fully erupted; all molars fully erupted but show little, if any, wear.
Stage III: P4 permanent; wear on M1 and M2 slight with no dentine showing; dentine may or may not be visible as small spots on M3.
Stage IV: dentine showing on up to half of surface of M1 and/or M2; M3 showing as much as two-thirds dentine.
Stage V: dentine showing on over half of surfaces of M1 and M2 and over two-thirds of M3; M3 worn smooth and M2 nearly smooth.

Since no known-aged squirrels were available the age in weeks or months of the different stages must be estimated. Stage I probably included squirrels between 6 and 10-12 weeks of age since young do not emerge from the nest until about 6 weeks and have all molars fully erupted by 10-12 weeks (Layne 1954). Likewise, Stage II probably includes squirrels between 10-12 and 19-20 weeks since P4 is either lacteal or being replaced during this period (Layne 1954). Stage III squirrels are possibly between 5 and 10-12 months of age since most of them were collected between September and March; young are usually born in April and May (Hatt 1929; Layne 1954; C. H. Halvorson, pers. comm.). Stage IV squirrels, based upon tooth-wear patterns in squirrels taken in the same month, would probably be about 1 to 3 years old, and Stage V squirrels are possibly over 3 years old.

Four skulls were measured 15 times each to determine measuring accuracy. A maximum error of 0.1 mm for all measurements except length of nasals (0.2 mm) was found.

RESULTS

Variation Due to Sex

Sample sizes in Stages I, II, and V were too small to warrant comparisons. No difference due to sex was found in any cranial measurement of Stage III skulls (Table 1). But significant differences ($P < 0.05$) due to sex were found in occipital-nasal length and zygomatic breadth in Stage IV skulls; and the

TABLE 1. — Variation in red squirrel skulls from Missoula County, Montana, due to sex

Measurement*	Stage III						Stage IV					
	Males		Females		*t*-value	Signif. level	Males		Females		*t*-value	Signif. level
	No.	Mean	No.	Mean			No.	Mean	No.	Mean		
Oc-nl lgth	19	48.19	9	48.06	0.40	ns†	18	48.81	24	48.15	2.33	.05
Lgth nsls	20	15.31	10	15.13	0.88	ns	18	15.66	25	15.41	1.82	ns
Zygmt brdth	20	27.72	10	27.70	0.08	ns	18	28.27	23	27.79	2.09	.05
Iorbt brdth	21	14.92	10	14.69	1.05	ns	18	15.12	25	14.92	1.72	ns
Porbt brdth	20	15.16	9	15.19	0.16	ns	18	15.22	24	15.05	1.41	ns
Pltl lgth	20	22.39	9	22.64	1.14	ns	18	22.64	25	22.49	0.98	ns
Plt wd @ Ml	21	5.29	10	5.32	0.33	ns	18	5.29	24	5.28	0.12	ns
Tth rw lgth	21	8.08	10	8.16	1.08	ns	17	8.09	25	8.13	0.63	ns
Brdth rstrm	21	7.64	10	7.72	0.78	ns	18	7.89	25	7.76	1.32	ns
Mndbl lgth	21	33.65	9	33.54	0.38	ns	18	34.07	24	33.84	1.18	ns

*See text for abbreviations of measurements.
†Not significantly different ($P > 0.05$).

t-values for length of nasals and interorbital breadth approached significance ($P < 0.10$). Stage IV males averaged larger than females in all measurements except palatal width at M1 and tooth row length. There is too much overlap to separate sexes by any cranial measurement.

Variation Due to Age

The data on age differences are shown in Table 2; sexes have been combined in each stage to increase sample size.

Significant ($P < 0.05$) increases were found among Stages I, II, and III in occipital-nasal length, length of nasals, zygomatic breadth, interorbital breadth,

TABLE 2. — Mean, standard error, and sample size for red squirrel skulls from Missoula County, Montana, by age group (sexes combined)

Measurement*	Stage I	Stage II	Stage III	Stage IV	Stage V
Oc-nl lgth	43.37† .734 3	46.49 .299 14	48.15 .152 28	48.43 .120 42	48.71 .240 14
Lgth nsls	13.17 .220 3	14.70 .142 15	15.25 .081 30	15.52 .074 43	15.60 .129 14
Zygmt brdth	24.50 .600 2	26.32 .226 12	27.72 .142 30	28.00 .116 41	28.32 .165 14
Iorbt brdth	13.50 .319 4	14.18 .142 15	14.85 .139 31	15.01 .057 43	15.29 .120 14
Porbt brdth	15.28 .166 4	15.07 .102 16	15.17 .088 29	15.12 .064 42	15.06 .111 14
Pltl lgth	21.30 .334 4	21.91 .168 15	22.47 .108 29	22.56 .081 43	22.63 .154 12
Plt wd @ M1	6.10 .091 4	5.54 .096 15	5.30 .045 31	5.28 .038 42	5.33 .063 12
Tth rw lgth	8.10 .057 3	8.10 .057 16	8.10 .038 31	8.11 .031 42	7.84 .054 13
Brdth rstrm	6.58 .150 4	7.19 .079 16	7.67 .051 31	7.82 .048 43	7.87 .082 11
Mndbl lgth	30.15 .366 4	32.06 .211 13	33.62 .135 30	33.94 .095 42	34.24 .159 14

*See text for abbreviations of measurements.
†Values given in order are: mean in mm, standard error of the mean, and number of skulls measured.

palatal length, breadth of rostrum, and mandible length (Table 3). A significant decrease was noted among these stages in palatal width at M1. No difference was found in postorbital breadth or tooth row length among these age groups. The significant changes noted in older squirrels were: increases in length of nasals between Stages III and IV, interorbital breadth between Stages IV and V, breadth of rostrum between Stages III and IV; and a decrease in tooth row length between Stages IV and V (Table 3).

Postorbital breadth and tooth row length show the least variation due to age (tooth row length decreases significantly in old squirrels as a result of wear). Occipital-nasal length, length of nasals, zygomatic breadth, interorbital breadth, breadth of rostrum, and mandible length all show a steady increase with age (Table 2).

Sample Size

A sample of about 110 Stage III or 160 Stage IV skulls, if the sexes are combined, would be statistically reliable at the 95 percent level. Respective sample sizes would be 75 and 110 at the 90 percent level, 50 and 70 at the 80 percent level, and 30 and 40 at the 68 percent level. If an equal sex ratio is assumed, the total sample required would be about the same when the sexes are separated as when they are combined. Sample size might be reduced somewhat if squirrels were collected during one part of one year instead of throughout several years as were the specimens used in this study.

DISCUSSION

Th results of this study agree with previous work and indicate that adult male red squirrels have slightly larger skulls than adult females (Hatt 1929; Layne 1954). This study also confirms the finding of Layne (1954) that these sex differences are not large enough to allow sex determination from any cranial measurement. I found a significant difference in zygomatic breadth in Stage IV skulls associated with sex, but Layne (1954) found no sex differences in this measurement.

The finding of significant increases in most cranial measurements associated with age agrees with data presented on other rodents by Allen (1894) and Hall (1926). Length of nasals and breadth of rostrum apparently continued significant growth longer than other cranial components.

Hall (1926) found that postorbital breadth and tooth row length increase little, if any, with age in ground squirrels (*Spermophilus beecheyi*); I found no increase in either measurement with age in red squirrels; and Findley (1961: 317) states that postorbital breadth in red squirrels ". . . does not change with increasing age or size". Layne (1954) has also shown that tooth row length does not increase with age after about 9 weeks. However, Findley (1961) reports that larger skulls have longer tooth rows.

The decrease I found in tooth row length is caused by wearing away of the widest part of the tooth crown and thereby allowing the teeth to move closer together; Allen (1894) found a similar decrease in *Neotoma micropus*. If the alveolar length of the tooth row, in place of the crown length, were used this decrease might be avoided.

TABLE 3. — Comparisons of red squirrel skull measurements between age groups (sexes combined)
Means and sample sizes appear in Table 2

Measurement*	Stages I vs. II		Stages II vs. III		Stages III vs. IV		Stages IV vs.V	
	t-value	Signif. level	*t*-value	Signif. level	*t*-value	Signif. level	*t*-value	Signif. level
Oc-nl lgth	3.94	.01	4.94	.01	1.44	ns	1.04	ns
Lgth nsls	5.83	.01	3.35	.01	2.45	.05	0.54	ns
Zygmt brdth	2.88	.05	5.65	.01	1.53	ns	1.58	ns
Iorbt brdth	1.95	ns†	3.81	.01	1.34	ns	2.11	.05
Porbt brdth	1.08	ns	0.74	ns	0.46	ns	0.47	ns
Pltl lgth	1.63	ns	2.80	.01	0.67	ns	0.40	ns
Plt wd @ M1	4.24	.01	2.26	.05	0.34	ns	0.68	ns
Tth rw lgth	0.00	ns	0.00	ns	0.20	ns	4.35	.01
Brdth rstrm	3.59	.01	16.00	.01	2.11	.05	0.53	ns
Mndbl lgth	4.52	.01	6.24	.01	1.94	ns	1.62	ns

*See test for abbreviations of measurements.
†Not significantly different ($P > 0.05$).

My data agree with those of Layne (1954) in indicating that individual variability in red squirrel skulls is small. It, therefore, appears that statistical analysis involving 100 to 200 skulls from any locality could be profitably undertaken for a taxonomic review of the red squirrel. I found highly significant ($P < 0.01$) differences in all 4 cranial parameters tested between Montana and New York squirrels (*T. h. loquax*) as reported by Layne (1954); *T. h. richardsoni* was larger. The limited data presented by Allen (1898) and Findley (1961) strengthen the possibility of basing red squirrel taxonomy on cranial measurements. However, this study indicates that skulls should be separated by age group, and possibly by sex, if comparisons between different populations are made for taxonomic or other purposes.

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NOTES ON MAMMALS IN ALPINE AREAS OF THE NORTHERN ST. ELIAS MOUNTAINS, YUKON TERRITORY AND ALASKA[1]

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THE St. Elias Mountains are situated in northwestern British Columbia, southwestern Yukon Territory, and reach their northern extent at the White River in Alaska (cf. Wahrhaftig, 1965, Plate 1). These spectacular mountains have the most extensive glacierization in continental North America. Extensive areas of alpine vegetation are found adjacent to the glaciers, and limited tundra is found on nunataks in the icefield. Incidental to botanical studies during the summers of 1965-68, observations were made on mammals in the vicinity of the Kaskawulsh, Steele, and Russell glaciers which are among those flowing eastward from the icefield on the continental slope of the range (Fig. 1).

Three study areas are along the Kaskawulsh Glacier and the Slims River. (1) Kaskawulsh Nunatak. At the edge of the icefield an extensive bedrock ridge protrudes through the ice and divides the upper Kaskawulsh Glacier into North and Central arms. At the extreme downglacier end of the nunatak is a low, vegetated knoll (Fig. 2) The knoll is about 20 miles upglacier from the glacier terminus and lies a few miles below the firn limit. It is separated by a mile of ice on each side from adjacent mountains. The relatively stable and vegetated surface is at 6000 feet, about 200 feet above the Central Arm, but somewhat less above the North Arm. The vegetated surface is less than ¼ mile in its longest dimension. (2) Observation Mountain. Just upglacier from the terminus and on the north side of the Kaskawulsh Glacier is a saddle at 5000-5500 feet between two ridges that reach 7000 feet (Fig. 3). The saddle drops abruptly to the glacier on one side and into the canyon of Canada Creek on the other. (3) Between Sheep and Bullion creeks in the mountains north of the Slims River is a large expanse of rolling tundra at 5000 feet, with ridge crests to 6000 feet. Muller (1967, p. 124, Plate 2) gives an aerial view of this locality.

Two study areas are in the vicinity of the Steele Glacier: (4) on the south wall at the big bend in the glacier at 5800-7000 feet (Wood, 1942, p. 46, Fig. 8 is an aerial view), and (5) on the north side of the valley at 6000-7000 feet (Wood, 1942, p. 46, Fig. 7 is a photograph of this area).

Three study areas at 4000-6000 feet are in the mountains flanking the upper White River on the south side: (6) near the Guerin Glacier, (7) near the Sheep Glacier, and (8) near the terminus of the Russell Glacier.

The Icefield Ranges Research Project (jointly sponsored by the American Geographical Society and the Arctic Institute of North America), under whose auspices the botanical studies were begun, has maintained camps in the icefield; one of these is the Seward Nunatak (9) at 6000 feet on the upper Seward Glacier on the coastal slope of the range (Wood, 1948, p. 110 is a photograph

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of this site). This is a small, sparsely vegetated nunatak. It is the most isolated of all the sites and is miles from extensive vegetation.

Little information is available concerning the mammals in the St. Elias Mountains, especially in remote interior areas. Banfield (1960) presented an annotated list of the mammals of the Kluane Game Sanctuary, of which two thirds is in the St. Elias Mountains, and he cited previous work in the area. This paper presents our notes and reports by other participants in the Icefield Ranges Research Project.

ANNOTATED LIST OF MAMMALS

GRIZZLY BEAR. *Ursus arctos*. We observed bears or sign at areas 1-8. At Observation Mountain, where the greatest variety of wildlife was seen, two Grizzly Bears (one brown and one blonde) were seen periodically throughout July 1966. The bears preferred cool, moist, north- and east-facing slopes where lush herb mats of the snow-flush areas provided food. One such site was near our camp, and we were able to observe a bear on 9 July as it alternately fed and rested for nine hours. The bear was sighted at 0930 hr.; it grazed until 1200 hr. when it lay on its side and rested for an hour. It fed again until 1430 hr., then rested until 1600 hr. After grazing until 1800 hr. it was alerted to our presence by the noise of radio contact with the project plane overhead. The bear went high onto talus and lay down and looked in the direction of our camp for 30 minutes before disappearing over the mountain at 1900 hr.

On 22 July a Grizzly Bear gave chase to 10 adult Mountain goats and 6 kids up a very steep slope. The speed and duration of the sprint was impressive, but the goats easily reached the safety of the ridge crest and disappeared. Another bear was seen running back and forth between ground squirrel burrows, presumably in an attempt to trap ground squirrels that had strayed too far from their burrows. Otherwise the bears spent their time seeking vegetable food. Studies on Grizzly Bear ecology are being conducted in Kluane Game Sanctuary by A. M. Pearson, Canadian Wildlife Service.

TIMBER WOLF. *Canis lupus*. Little Timber Wolf sign was observed along the Kaskawulsh and Steele drainages, and only one was glimpsed in the forest on the north side of the Slims River. At the upper White River in Alaska, sign was more common where tracks of wolves, caribou, and grizzly dotted many gravel bars.

COYOTE. *Canis latrans*. Tracks were seen frequently along the Slims River floodplain and up into the tundra, and yapping was heard on several occasions when we camped near site 3.

RED FOX. *Vulpes vulpes*. Red Foxes were seen at Observation Mountain, the north side of the Steele valley, and along the upper White River. One afternoon we observed a Red Fox barking at and advancing toward a Wolverine. The Wolverine was backing away and was in no apparent hurry to break off the encounter.

WEASEL. *Mustela* sp. A weasel (probably *M. erminea*) was sighted on two occasions in the first week of August 1964, at the Seward Nunatak. It was believed to be feeding on bird remains at the base of a cliff (Ray Lougeay, personal communication). This is just one of several remarkable cases of mammals having traveled long distances over glaciers. Pruitt (1957) reported a weasel at 15,000 feet on Mt. McKinley, Alaska, and concluded that it had "traveled some two vertical miles above timberline . . . before dying, presumably of starvation."

WOLVERINE. *Gulo gulo*. Reported by Banfield (1960) as common. A Wolverine was seen five times in July (twice on the 8th at 0900 hr. and 1600 hr., at 0400 hr. on the 9th, and at 0200 hr. on the 12th, in addition to the fox incident on the 17th) at Observation Mountain. Its curiosity was not dampened by being chased twice by our dog, when it again exhibited no signs of aggressiveness. Other Wolverines were seen on the south side of the Steele Glacier (Walter A. Wood, personal communication) and at 7000 feet on a small glacier near the Steele Glacier (Michael Hebb, personal communication) in August 1967.

FIGURE 1. Study areas.

COUGAR. *Felis concolor*. The nearest reliable (published) records of Cougar are from northern British Columbia (Rand, 1944) and from west of Watson Lake, Y.T. (Youngman, 1968). However, during 1964-1966 residents along the Alaska Highway between Haines Junction and Burwash Landing and some Icefield Ranges Research Project personnel reported sighting a Cougar along the Alaska Highway and the environs of the south end of Kluane Lake. Neither these sightings nor the reference in Wood (1967) have been verified. Nevertheless, it is significant that people from the area and familiar with the wildlife caught glimpses of an animal they could not immediately identify.

LYNX. *Lynx canadensis*. We saw no live Lynx but found an entire Lynx skeleton in

a snow accumulation area on the Kaskawulsh Nunatak in 1965. They have been seen well into the icefield near the base of Mt. Bering and on the Lowell Glacier (M. E. Alford, 1966, personal communication).

HOARY MARMOT. *Marmota caligata*. Marmots were not observed by Banfield (1960) but were reported by Cameron (1952). We saw only two marmots at Observation Mountain in July 1966.

ARCTIC GROUND SQUIRREL. *Spermophilus undulatus*. Arctic Ground Squirrels are common from meadows and flats at Kluane Lake (2600 feet) to the alpine areas, where they are found on tundra and on sparsely vegetated moraines up to 6500-7000 feet. The most detailed observations were made between 1 July and 1 August 1965 on the Kaskawulsh Nunatak, where there were at least 13 adults, 7 with young. The ground squirrel population more than doubled in 1965; at least 23 young were born in litters of one to four.

The limited habitat restricts the size of the population, and once maximum numbers are attained, dispersal of the annual increment becomes a necessity. Even before the emergence of the young, all suitable habitat on the knoll was utilized by the adult population. In July 1967 we noted no further development of burrow systems, which indicates that the carrying capacity of the terrain had been reached.

In addition to dispersal, the origin of the population is a problem, since the nunatak is separated from adjacent mountains by a mile of ice. Two routes are possible for migration to or emigration from the nunatak. The stock for the population may have originated from the areas of tundra at the glacier terminus for which the medial moraine could have served as a route to the nunatak. However, this is unlikely, since it would require a 15 to 20 mile trek over rough, essentially vegetation-free terrain. A more likely source is from known ground squirrel populations in mountains directly across the ice from the nunatak, where tundra vegetation is present, but discontinuous (Peter Anderton and Gil Dewart, personal communication). In this case the medical moraine could serve to direct ground squirrels crossing the glacier from either side, downglacier from the nunatak.

The nunatak could have been visited first during Hypsithermal time when its surface was ice-free, and the glacier terminus had begun its retreat. Maximum retreat is documented to within about 10 miles of the nunatak (Denton and Stuiver, 1966) and is postulated to a few miles upglacier of the nunatak (Borns and Goldthwait, 1966), which would place the nunatak in contact with the valley floor.

Due to their impact on the vegetation, it is unlikely that an Arctic Ground Squirrel population could persist for a long period of time on the nunatak. Burrowing activity obliterates or buries vegetation. This and geomorphic processes promote soil instability, thus revegetation is slow.

Young were first seen on the nunatak on 11 July around a burrow system which had been snow covered until the end of the first week in July. The mother grazed at a considerable distance from the young, and even remained in the burrow for up to 20 minutes while the young grazed and dozed near the burrow entrance. Two weeks after emergence the young were ranging far out of the territory of their natal burrow and were digging and "hay collecting." The ground squirrels did not appear to be wary, and no predation was observed during July 1965, probably because of our presence. However, grizzly and canid scats and the Lynx skeleton indicate that these predators visit the area. Any large predator could drastically reduce population size in a short time. An Arctic Ground Squirrel carcass was found decomposed intact indicating that predators do not necessarily reach the nunatak each year. No raptors were seen, but skeletal remains of one were found.

Ground squirrel territories were well defined and covered most of the vegetated surface. Boundary squabbles occurred every morning, and the antagonism between ground squirrels seemed to be of greater intensity and frequency than on the tundra above the Slims River where extensive habitat was available. Late in July there were signs of antagonism between mothers and young. One young ground squirrel was seen on the moraine 200 feet below the nunatak in early August.

Greatest population pressure occurs in the fall when the young of the year require hibernacula, and probably most emigration attempts would be made then. However,

FIGURE 2. Kaskawulsh Nunatak.

glacier conditions would be most hazardous for ground squirrels at this time. Since the nunatak lies below the firn limit, the cover of snow melts by late July. Consequently crevasses are no longer bridged, and the ice surface is crisscrossed by meltwater streams, some of which are swift and deep. Early spring conditions would present far less difficulty, but then one would expect the necessity to seek new territories to be less severe.

A behavior study with a tagging and recapture program on the nunatak and flanking mountains could yield information as to the dynamics of an Arctic Ground Squirrel population in a restricted and isolated area, and whether or not they do, in fact, repeatedly attempt movement across the glacier, and if so, at what season, and with what success. Since a weasel was seen on the Seward Nunatak and pikas or pika sign have been found there and on the Kaskawulsh Nunatak, it is apparent that these small mammals are also capable of crossing large expanses of ice. A. H. Tinker (personal communication) confirmed by trapping without success in 1966 our impression that mice and voles are not on the Kaskawulsh Nunatak.

SINGING VOLE. *Microtus gregalis* (*M. miurus*). We did no trapping, but the distinctive haypiles (consisting here of *Salix arctica* and *S. barrattiana*) and their "singing" identified a population of *M. gregalis* on the tundra between Sheep and Bullion creeks in 1966. There was more sign in 1967, and the population was obviously high. We noted at least 25 burrow entrances in an area 5 by 8 feet. By June 1968 the population had crashed; no animals were seen and much of the old haypiles remained, although on the north side of the Steele valley *M. gregalis* were plentiful. During 1967 when the mouse population was high between Sheep and Bullion creeks, numbers of this species were low at nearby Kluane Lake (A. H. Tinker, personal communication).

COLLARED PIKA. *Ochotona collaris*. Pikas were observed in areas of blocky talus at Observation Mountain and in the vicinity of Steele Glacier among moraine boulders and in talus. Pikas or sign have also been noted well into the icefield. According to Walter A. Wood (1948, and personal communication) pikas were found on Seward Nunatak and other nunataks in the vicinity in 1945 and 1948 but were not seen in 1951. We found old pika scats and the remains of a haypile in the talus of a snow accumulation area on the Kaskawulsh Nunatak. No pikas were heard or observed there in July 1965, 1966, or 1967.

PORCUPINE. *Erethizon dorsatum*. A Porcupine was seen on 4 July 1968 at 5500 feet on the tundra between Sheep and Bullion creeks.

MOOSE. *Alces alces*. Banfield (1960) mentioned evidence of feeding and tracks on the tundra. We saw Moose tracks along an old mining road in the tundra above the Slims River. The road was heavily used since it is a convenient route through the shrub zone between the forest and tundra. Tracks and scats of bear, moose, fox, and coyote were common.

Three Moose were seen together on two occasions a week apart on the tundra at Observation Mountain in 1966. They spent 18 hours there on 15 July and 12 hours there on 23 July and climbed on talus to 6000 feet and rested high on the slope for several hours not far from a band of White Sheep.

CARIBOU. *Rangifer tarandus*. Caribou were observed on the Burwash Uplands west of Kluane Lake and in the White River valley, on the floodplain and on the tundra. Several sets of small antlers, presumably from females, were found on high, exposed tundra slopes near Sheep Glacier indicating that this may be an area of calving.

WHITE SHEEP. *Ovis dalli*. Banfield (1960) presented a distribution map for White Sheep in the Kluane Game Sanctuary. They are common throughout the St. Elias Mountains; we saw them at locations 2-8. We camped at Observation Mountain from 6 July to 2 August 1966. Bands of 5 to 20 adults were seen daily. Small bands of lambs and ewes appeared for the first time that season on 25 July and were often seen after that date. Undoubtedly they had been hidden in more precipitous areas. As the summer progressed, the bands of sheep stayed higher on the mountain, perhaps to remain near the retreating edge of snowbanks to feed on the new vegetation.

FIGURE 3. Observation Mountain, saddle.

MOUNTAIN GOAT. *Oreamnos americanus.* Banfield (1960) stated that local reports placed goats in the Alsek River valley alone. We observed goats at Observation Mountain and in the mountains flanking Bullion Creek, and in 1914 Auer (1916; cf. Rand, 1945) hunted and photographed them in the Slims River Canada (Kennedy?) Creek area.

Mountain Goats have been seen on the Kaskawulsh Nunatak in 1964 (Peter Anderton, personal communication), and many "beds" and scats were found there. A recent sighting near the mouth of Steele Creek (Cliff Armstrong, personal communication) places goats further north along the range. It is possible that Mountain Goats are now extending their range east and north in the St. Elias Mountains.

At Observation Mountain one, two, and three males were seen from time to time until 21 July when does and kids appeared. The males often rested and grazed near and even mixed with bands of White Sheep. The nursery bands ranged in size from 2 to 10 adults with up to 6 kids.

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OBSERVATIONS OF MOOSE FEEDING ON AQUATICS IN BOWRON LAKE PARK, BRITISH COLUMBIA

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Bowron Lake Provincial Park (lat. 53°N., long. 121°W.) features a chain of lakes forming a rough square with a perimeter of approximately 73 miles. Smaller lakes in the southwest part of the park are shallow, relatively warm, and with little glacial influence while the large lakes are narrow, deep, and fed by glacial streams.

Moose (*Alces alces*) are abundant summer residents along the slow moving Bowron River and adjacent lakes. We were able to record their feeding behavior on aquatics during the summer of 1962. The observations were made during a general wildlife survey of the park.

Methods

Observations were made from July 20 to August 16, 1962. A 10-minute observation period was taken as a standard. During each observation period every identifiable food eaten was recorded. Identification of underwater food was possible from portions of the plant or plants hanging from the moose's mouth after surfacing, or from floating parts that appeared after feeding was completed.

The major food item per observation period was also recorded. This was usually easy as many aquatics occurred in pure stands. In mixed stands, identified items were counted. It was necessary to make a subjective choice of the main food item in only a few cases.

Habitat

Three types of favored aquatic feeding areas were evident:

1. Lakes and ponds with little or no current, banks relatively steep and emergent vegetation generally scarce. These waters had heavy growth of various species of pondweed of which large-leaved pondweed (*Potamogeton amplifolius*) and common floating pondweed (*P. natans*) were most abundant. *P. robinsii* occurred in scattered localities. There were few beds of horse-tail (*Equisetum* spp.) or of bur-reed (*Sparganium* sp.).

2. Ponds with shallow banks and temporarily flooded marshes. Here emergent vegetation was abundant. Higher parts of the meadows were dominated by sedges (*Carex* spp.), with a few grasses scattered throughout. Buck-bean (*Menyanthes trifoliata*), was common in wet depressions and on floating hummocks. The transition from meadow to open water was marked by almost pure stands of swamp horsetail (*E. fluviatile*). The transition between marsh edges and the surrounding coniferous forests included stands of bog birch (*Betula glandulosa*), alder (*Alnus* sp.), and scattered willows (*Salix* spp.).

3. Ponds showing the influence of river currents and the slow flowing river between the ponds. The most abundant aquatic in the river was *Potamo-*

TABLE 1. — Aquatic foods eaten by moose, Bowron Lake Park

Food	Occurrence in observations	% occurrence in observations	Occurrence as principal food	% occurrence principal food
Equisetum fluviatile	35	56.0	25	39.5
Sparganium spp.	28	42.4	18	25.7
Potamogeton spp.	24	36.4	16	24.2
Carex spp.	7	10.6	0	
Menyanthes trifoliata	5	7.6	5	7.6
Salix spp.	4	6.0	0	
Ranunculus sp.	2	3.0	0	
Potentilla palustris	2	3.0	0	
Characeae	1	1.5	1	1.5
Lobelia sp.	1	1.5	1	1.5
Cornus stolonifera	1	1.5	0	
Totals	110		66	100.0

geton richardsonii; ponds had extensive beds composed solely of bur-reed. Borders of the river and ponds were composed mainly of horsetail (primarily swamp horsetail). Willows along the shore were mostly dead or dying as a result of drowning. The survivors were subjected to beaver cutting and moose browsing.

RESULTS

A total of 66 observations was made in which the major food or foods were identified. This covered a period of eleven feeding hours and approximately 20 different moose were involved.

The most important food was swamp horsetail (Table 1). It occurred in over half of the observations and was the major food in almost 40%. Murie (1934) and Shelford and Olsen (1935) noted that horsetail was an important aquatic food.

Moose feeding on horsetail grazed the stems from a few inches above the water surface to a few inches below. Usually the plants were chewed off at the surface and about 6 – 12″ of stem was eaten.

De Vos (1958) found that horsetail was eaten until mid-June and suggested that palatability may decrease after this time. No decrease in use was noted in this study through July to mid-August. By then, 90% or more of the tips had been grazed over large areas.

Bur-reed was recorded as the second major food item although species were not identified as few of the plants were in fruit. Use of bur-reed by moose has been recorded in Alaska (Palmer 1933), in Ontario (Peterson 1955, by Cringan in De Vos 1958 study). In Wells Gray Park, British Columbia, it is the chief aquatic food.

McCabe and McCabe (1928) stated that 'a sedge of a more fleshy type, with a triangular stem, is an autumn delicacy' in their study of the Bowron

Lake moose. This 'sedge' was described as having its leaves flat and growing along the surface of the water for a foot or more. They examined stomachs crammed with this material. We believe this to be a species of bur-reed rather than a sedge.

Two methods of feeding on this plant were observed. Usually moose walked or swam about picking up mouthfuls of floating leaves. Alternatively, the head was submerged to just below eye level with leaves, stems, and sometimes roots being eaten. No noticeable depletion of bur-reed beds occurred through the study period.

Use of several species of pondweed was recorded: *Potamogeton richardsonii*, *P. robinsii*, *P. gramineus*, *P. natans*, and *P. amplifolius* in order of occurrence. Other narrow-leaved pondweeds were eaten but not positively identified. Although it would be difficult to determine the preference for the various species, it appeared that *P. robinsii* and *P. richardsonii* were taken more frequently, in relation to their abundance, than the others. De Vos (1958) records use of seven species of pondweed in Ontario, four of which were eaten in this study.

In 12 of 20 observations moose feed with the head more or less completely under water to obtain pondweeds. Diving was observed twice. The plants involved in surface feeding were often those washed up along the shore by storms after being cut loose by outboard motors or feeding moose. The pondweeds showed no evidence of being depleted by heavy feeding.

Pondweed use might have been heavier in the absence of tourist traffic. The main travel route for boats dissected some of the better pondweed areas.

The occurrence of all other foods as major items in the diet totalled approximately 10%. Some of these may be classified as semi-aquatics but we have preferred to use the definition of Fassett (1957) for an aquatic: 'a plant that may, under normal conditions, germinate and grow with at least its base in the water and is large enough to be seen by the naked eye.'

The water line on feeding moose was recorded in each observation. The observations (Table 2) showed that adults tended to feed in deeper water than yearlings and that calves fed only in shallow water. However, yearlings were often seen swimming and calves were seen swimming on occasion. This suggests that deep water feeding is probably learned much after the ability to swim. Observations in Wells Gray Park substantiate these findings.

There were insufficient data to evaluate the influence of climatic factors on aquatic feeding. The situation further defied statistical analysis because disturbances by boaters were more numerous on hot, clear days. De Vos (1958) saw more moose along lakes in Ontario during clear periods than during light rains. We believe that deep water feeding occurs more frequently on hot days and that flies may induce moose to use deeper water. On several occasions, moose were seen shaking their heads with lowered ears when they lifted their heads from the water. The flies which attacked the exposed heads appeared to be large tabanids.

The nutritive value of aquatic plants eaten by moose has not been examined. However, almost all moose observed in this study were in good condition by

TABLE 2. — Observed waterline on feeding moose

Age	Feet to hocks		Hocks to belly		Belly to back	
	# of observations	% of observations	# of observations	% of observations	# of observations	% of observations
Adults	24	49	15	31	10	20
Yearlings	14	93	1	7	—	—
Calves	3	100	—	—	—	—
All moose	41	61	16	24	10	15

the end of summer. As aquatic plants appeared so frequently in our observations we believe that they formed the bulk of the summer diet (although examination of the periphery of the study area showed that moose ate considerable portions of browse in the form of deciduous leaves). We further believe the nutritional state of moose in this region by summer's end must depend, to a large part, on their intake of aquatic plants.

SUMMARY

Observations of moose summering on the lakes and rivers of Bowron Lake Park showed their distribution to depend on lakes with relatively shallow, warm water. Plants of three genera: *Equisetum*, *Sparganium*, and *Potamogeton*, were the most important foods. Adult moose fed more frequently in deep water than did yearlings. Calves did not feed in deep water. A high percentage of available horsetail tips were browsed but no depletion of other important foods was noted. The moose appeared to be in a good state of nutrition after summering for a large part on aquatic vegetation.

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BREEDING BIRDS OF THE WEST MIRAGE ISLANDS, GREAT SLAVE LAKE, N.W.T.[1]

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The avifauna of the Great Slave Lake area has not been intensively investigated. Preble (1908) made general notes on birds of parts of the lake, and more recently several biologists have studied birds of the lakes and rivers south of Great Slave Lake (Soper, 1957; Stewart, 1966; Nero, 1963). Even with the new access road from Edmonton, Alberta, to Yellowknife, Northwest Territories, there has still been relatively little ornithological research on the north shore of the lake. Perhaps this is because currently there is more intense interest in the ecology of tundra regions.

Great Slave Lake lies in the transition between the forested Mackenzie Lowlands and the more rugged Laurentian Shield. A unique feature of the northern lake shore is the complex of islands lying in deep water at various distances from the mainland. Our survey was intended to determine the bird fauna of an isolated group of islands with a view to future intensive investigation of the avian community in relation to size of land mass, habitat, and the importance of barriers. Special emphasis was placed on the Greater Scaup (*Aythya marila*) because the nesting ecology of this species has been little studied and because information was desired for comparison with the Lesser Scaup (*Aythya affinis*) being studied concurrently on inland lakes on the north side of Great Slave Lake by Trauger.

Study Area

An isolated group known as the West Mirage Islands was selected for this study (Figure 1). They are located approximately 13 miles S.S.W. of Yellowknife, Northwest Territories, and approximately 3½ miles from the mainland (Lat. 62°16′, Long. 114°29′). The group consists of approximately 97 islands of which we searched 73 (Figure 2). These islands vary in size from barren rock islets 20 feet in diameter to well-vegetated islands of an estimated 16 acres. Although some islands were very closely spaced, we have considered them as separate entities for simplicity in record-keeping. It usually was necessary for us to move from one island to another by boat. Most islands were less than 100 yards apart with the maximum distance between islands being about 650 yards. These islands are composed of dark, fine-grained, black basalt in contrast to the uniform red-granite islands and substrate nearer the mainland. No island exceeds 25 feet in height, and all appear to have been submerged during recent geologic times. Based on hydrographic maps, water depths around the islands range from 13 to 180 feet, and the islands are characterized by very abrupt shorelines (Figures 3). Many appear to be completely washed during storms because driftwood is found 10 feet or higher above the water (Figure

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FIGURE 1. Aerial view of the main cluster of the West Mirage Islands, looking NNW.

FIGURE 2. Map of the West Mirage Islands showing locations (black) of islands checked for nests.

FIGURE 3. Vista of Islands to show rocky and sparsely-vegetated as well as "wooded" islands. Note abrupt shorelines and driftwood.

3). This also may be due to varying water levels since the levels were reportedly several feet lower than normal.

Because of the size and depth of Great Slave Lake, it becomes icefree several weeks after small lakes on the mainland. In general, the phenology of the area was between 2 and 3 weeks behind that of the mainland. Undoubtedly, this has an important bearing on the species of birds that utilize the islands and on the chronology of their nesting. Although continuous observation would be necessary to determine comparative chronology of nesting of island versus mainland birds, there was less difference in nesting chronology than vegetation would imply. Our study was made on June 30 and July 3-5, 1968, and most species obviously were well into the nesting cycle and several were rearing young. Trauger photographed the West Mirage Islands on May 29 when they were completely icebound. According to local observers, ice left Yellowknife Bay on June 22 which would not have allowed sufficient time for water birds to have reached the incubation stages we observed 10 days later. Krapu, however, photographed the islands from the air on June 5. An examination of these photos showed a belt of open water along the edges of the islands that would have allowed water birds to swim and feed.

As Preble (1908:98) noted, the vegetation of the islands of Great Slave Lake has the rugged, sparse appearance of the boreal forest-tundra ecotone rather than the boreal forest of the mainland near Yellowknife. Vegetation

FIGURE 4. Ground-level boughs of spruce adjacent to dead trunk. The observers are examining the nest-site of a Red-breasted Merganser.

ranges from dry tundra lichens and mosses with a few tufts of grass to Labrador Tea (*Ledum groenlandicum*), gooseberry (*Ribes* sp.), scrubby willow (*Salix* sp.), white birch (*Betula papyrifera*) and black spruce (*Picea mariana*). Willow trees in protected sites do not exceed 6 feet in height. Most birch trees were 8-12 feet tall, and most black spruce were 10-20 feet (Figure 3). Most spruce show the effects of exposure to this harsh environment and have few branches high on the tree, but many sprawling ground-level branches (Figure 4).

These islands provide an excellent example of primary succession. Many rocks are bare and polished (presumably by ice as well as water), and no plants except algae grow at the water-line (Figure 3). Other dry, rocky areas are populated with lichens, and level areas often have a trace of soil and a thin layer of mosses (Figure 5). Small depressions and cracks hold sufficient soil to support dense clumps of grasses (mainly *Calamagrostis* sp.) (Figure 6). Clumps of grass also occur near water level of gradual shorelines (Figure 7). Rocky depressions near the shore often are barren pools, but a few shallow basins have submergent vegetation. Deeper pools have a partial to continuous moss and sedge mat (Figure 8). Those in more advanced stages have little visible water, but have Labrador Tea at the perimeter and willows at the edge. Some idea of the rate of plant invasion into pools is suggested by a boggy area on the island where we camped. According to aerial photographs taken in

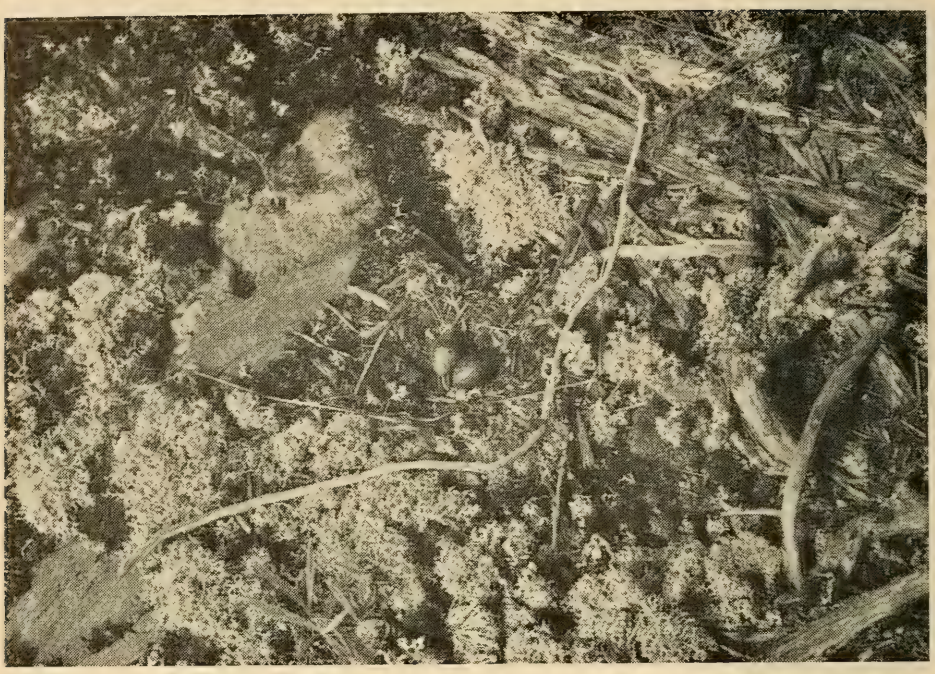

FIGURE 5. Nest-site of Arctic Tern in a slight depression. Note modest amount of nest material, and adjacent lichen.

1945, there was an open pool not apparent in 1968. Spruce and birch are found only in areas that have soil in rock cracks or shallow depressions.

These islands have been less influenced by man than most islands closer to the mainland. But, they are far from pristine. The islands have been used to some degree as campsites for commercial fishermen and are littered with packaging crates and food containers in certain areas. On two islands, fires have resulted in serious damage to both tundra and timber. Fishermen have also waged a campaign against Bald Eagles, which they consider destructive to fish. On one island serious damage was done by the exploding of surplus war-time weapons. This has, however, created an interesting area to study the succession of plants and bird life.

Enroute to the West Mirage Islands, nine islands along shore were visited. These islands often were more wooded and the trees were of considerably larger size. Notes on seven of these islands are included because they were similar in physiography and fauna.

METHODS

We expended 10 long man-days of effort on June 30 and July 3-5, 1968. On each island three or four men walked side by side searching every available niche for birds and nests. Most islands were cover-mapped by a quickly made sketch map showing: 1, island shape; 2, distribution of trees; 3, barren rock outcrops; 4, extensive tundra areas; and 5, isolated pools. We also camped for

two nights on the largest island where we gained a more intimate contact with the activities of certain birds.

Topographic maps were used as a base for locating and numbering islands. Numbers then were used for recording all data. Aerial photos as well as the topographic maps allowed us to place islands into certain size and vegetation categories. A dot grid was used for comparing size of the areas from an enlargement of a topographic map. Precise acreages of these islands are not available at this time, but size estimates based on measurements of the topographic maps ranged from less than ⅓ acre to about 16 acres.

RESULTS

Species Composition

Because of the harsh environment, delayed phenology, and sparse tundra-like vegetation, it is not surprising that this intensive survey yielded evidence of only 35 species of birds. Although no avifaunal studies have been made on the mainland, an estimate of number of breeding land birds by MacArthur and Wilson (1967:116) indicates approximately 81 species occurring on the north side of Great Slave Lake. Only highly adaptable or island-nesting species occurred on these islands.

Of the 35 species found on the islands, 17 were observed nesting or caring for young. These 17 species are listed in Table 1 by their frequency of occurrence on islands. Because one would not expect all birds to be nesting concurrently, the frequency of sighting of these birds on each island rather than the frequency of nesting seems to be the best measure of their relative abund-

TABLE 1. — Frequency of occurrence by islands of birds nesting and birds observed on 73 of the West Mirage Islands.

Species	Freq. of occur. of Nesting	Freq. of occur. of Sighting
Savannah Sparrow (*Passerculus sandwichensis*)	3[1]	32[2]
Greater Scaup (*Aythya marila*)	22	26
California Gull (*Larus californicus*)	15	17
White-crowned Sparrow (*Zonotrichia leucophrys*)	2	16
Arctic Tern (*Sterna paradisaea*)	13	16
Herring Gull (*Larus argentatus*)	13	13
Red-breasted Merganser (*Mergus serrator*)	6	11
Northern Phalarope (*Lobipes lobatus*)	2	9
Parasitic Jaeger (*Stercorarius parasiticus*)	3	9
Myrtle Warbler (*Dendroica coronata*)	1	7
Green-winged Teal (*Anas carolinensis*)	1	6
Mew Gull (*Larus canus*)	3	5
Pintail (*Anas acuta*)	1	5
Caspian Tern (*Hydroprogne caspia*)	3	4
Red-throated Loon (*Gavia stellata*)	2	3
Song Sparrow (*Melospiza melodia*)	1	3
Mallard (*Anas platyrhynchos*)	1	2

[1]Indicates that nests were found on 3 of 72 islands surveyed.
[2]Indicates that birds were observed on 32 of 72 islands surveyed.

TABLE 2. — Numbers of nests examined, arranged according to abundance.

Species	West Mirage Islands	Shoreward Islands	Total
California Gull	92	27	119
Arctic Tern	48	42	90
Greater Scaup	40	9	49
Herring Gull	22	3	25
Red-breasted Merganser	5	0	5
White-crowned Sparrow	5	0	5
Parasitic Jaeger	3	2	5
Caspian Tern	3	1	4
Savannah Sparrow	3	0	3
Red-throated Loon	2	0	2
Pintail	2	0	2
Mew Gull	1	1	2
Northern Phalarope	1	0	1
Mallard	1	0	1

ance (Table 1). Using the frequency of nesting, the five species of most frequent occurrence by islands were: Savannah Sparrow, Greater Scaup, California Gull, White-crowned Sparrow, and Arctic Tern. Although no direct counts were made, we would estimate total populations on all islands to produce an order of abundance of: California Gull, Arctic Tern, Savannah Sparrow, Herring Gull, and Greater Scaup. This order is reflected better but not completely in numbers of nests recorded (Table 2).

Twelve other species were seen in the area (Table 3), and all but the Yellow-billed Loon could be considered potential breeding birds. Evidence of 6 other species also was found, but these birds were not actually seen (Table 4), and two undoubtedly were winter residents. Our local guide, Mr. William McDonald, has visited these islands for many years and indicated that three other species had been recorded nesting there: Canada Goose (*Branta cana-*

TABLE 3. — Frequency of occurrence of birds observed on 73 West Mirage Islands but for which no nests, young or positive evidence of breeding was recorded.

Species	Freq. of occur.
Common Loon (*Gavia immer*)	3
Common Goldeneye (*Bucephala clangula*)	3
Common Raven (*Corvus corax*)	2
Yellow Warbler (*Dendroica petechia*)	3
Yellow-billed Loon (*Gavia adamsii*)	1
Common Scoter (*Oidemia nigra*)	1
Common Merganser (*Mergus merganser*)	1
Sora (*Porzana carolina*)	1
Spotted Sandpiper (*Actitis macularia*)	1
Semipalmated Sandpiper (*Ereunetes pusillus*)	1
Common Redpoll (*Acanthis flammea*)	1
White-throated Sparrow (*Zonotrichia albicollis*)	1

TABLE 4. — Evidence of the occurrence of birds not actually observed during field work in 1968

Species	Evidence	Freq. of occur.
Willow Ptarmigan (*Lagopus lagopus*)[1]	Wings, bones, and droppings	20
Yellow-shafted Flicker (*Colaptes auratus*)[2]	Wing and tail feathers	2
Lesser Scaup (*Aythya affinis*)[2]	Eggs in 2 Greater Scaup nests	1
Short-eared Owl (*Asio flammeus*)[1]	Wing (incomplete albino)	1
Northern Three-toed Woodpecker (*Picoides tridactylus*)[1]	Foot, leg and part of wing	1
Bald Eagle (*Haliaeetus leucocephalus*)[2]	Old nest; many wing feathers	1

[1]Probably winter residents or migrants.
[2]Probably rare breeding birds or summer residents.

densis), Oldsquaw (*Clangula hyemalis*), and Hudsonian Godwit (*Limosa haemastica*).

Evidence was encountered of 3 species of mammals. A muskrat (*Ondatra zibethicus*) was seen on one island and a muskrat lodge was present at the base of a willow tree at a pool edge. Remains of snowshoe hares (*Lepus americanus*) were common, and remains of caribou (*Rangifer tarandus*) were found on two islands. Caribou occur only rarely at Yellowknife in winter now.

Nesting

Although major effort was devoted to determining the presence or absence of a species on each island, an attempt was made to locate all nests and record clutch size and nest-sites. Nests of 14 species were found (Table 2). Almost all birds of the West Mirage Islands and of the more barren shoreward islands were ground nesters and many were colonial. Presumably, there are few ground-level predators.

In this dry climate, the rate of deterioration is very slow. Several old nests of Greater Scaup were found which held shells and membranes of the previous year. One hen was incubating a clutch on what was obviously last-year's site because old shells and membranes were found beneath the eggs. A related situation was that some gull nests found empty may have been those from a previous year; however, the age of the nest materials was such that no certain judgment could be made.

Nests of several species of birds tended to be closely spaced. Indeed, California Gulls were highly social and were restricted to a few island colonies with nests as close as 4 feet. Two Greater Scaup nests were only 7 feet apart, and the only 2 Pintail nests found were in the same patch of Labrador Tea and 60 feet apart.

Predation on eggs of ducks was especially common but the predator was not determined. Any of the gulls or the Parasitic Jaegers could have been responsible but Ravens also were seen. Shells of eggs of Greater Scaup and Red-breasted Mergansers usually were found under trees suggesting that Ravens were responsible. But shells also were found in open areas. In one instance,

TABLE 5. — Clutch size of 49 Greater Scaup nests

	West Mirage Islands			Shoreward Islands			Totals		
	M. (± S.D.)	RG.	No.	M. (± S.D.)	RG.	No.	M. (± S.D.)	RG.	No.
All nests found	7.5 (4.32)	1–16	40	9.2 (5.10)	5–22	9	7.8 (4.51)	1–22	49
Incomplete clutches only	2.1 (1.14)	1–3	11	5.0	5	1	2.3 (1.38)	1–5	12
Warm clutches only[1]	9.1 (2.59)	5–16	29	9.7 (5.17)	6.22	8	9.3 (3.87)	5–22	37
Warm clutches minus those obviously parasitized[2]	8.6 (1.78)	5–12	27	8.0 (1.63)	6–11	7	8.5 (1.77)	5–12	34

[1]This may include some laying birds because eggs were not candled to determine whether they were incubated.
[2]All clutches exceeding 12 eggs were considered parasitized.

TABLE 6. — Numbers of nests and clutch sizes of birds other than Greater Scaup, arranged taxonomically
Standard deviations are included for species represented by 4 or more nests

	West Mirage Islands			Shoreward Islands			All nests		
	M. (± S.D.)	RG.	No.	M. (± S.D.)	RG.	No.	M. (± S.D.)	RG.	No.
Red-throated Loon	2.0	–2–	2	—	–	—	2.0	–2–	2
Pintail	5.5	5–6	2	—	–	—	5.5	5–6	2
Red-breasted Merganser	7.7 (.52)	7–8	4	—	–	—	7.7 (.52)	7–8	4
Northern Phalarope	1.0	–1–	1	—	–	—	1.0	–1–	1
Parasitic Jaeger	1.3	1–2	3	2.0	–2–	2	1.6 (.55)	1–2	5
Herring Gull	1.7 (.63)	1–3	22	2.3	2–3	3	1.8 (.64)	1–3	25
California Gull	1.9 (.66)	1–3	92	1.8 (.59)	1–3	27	1.9 (.64)	1–3	119
Mew Gull	3.0	–3–	1	3.0	–3–	1	3.0	–3–	2
Arctic Tern	1.7 (.48)	1–2	48	1.7 (.47)	1–2	42	1.7 (.47)	1–2	90
Caspian Tern	1.7	1–2	3	3.0	–3–	1	2.0 (.82)	1–3	4
Savannah Sparrow	5.0	–5–	1	—	–	—	5.0	–5–	1
White-crowned Sparrow	4.2 (.87)	3–5	5	—	–	—	4.2 (.87)	3–5	5
Total number nests			184			76			260

shells of about 10 Greater Scaup eggs were scattered in an open area less than 50 feet square.

Clutch-size

Mean clutch size, range and sample size are given in Table 5 for the Greater Scaup and in Table 6 for other species.

Some interspecific parasitic laying was noted among the waterfowl. One Red-breasted Merganser nest of 4 eggs also held 2 Greater Scaup eggs. Two Greater Scaup nests held Lesser Scaup eggs: One nest of 8 eggs held a single Lesser Scaup egg, and a nest of 10 Greater Scaup eggs had 1 Greater and 3 Lesser Scaup eggs outside the nest in the vegetation and water. Obviously, some fighting had occurred between hens.

Intraspecific parasitism was common. One Greater Scaup nest held 22 eggs and 2 held 16 each. All three nests were well cared for and incubated when found but the nest of 22 eggs had one egg outside the nest. Thus, the best estimate of clutch size in Greater Scaup was calculated on the basis of using only warm nests and those that did not exceed 12 eggs (Table 5). This follows the system used by Weller (1959) for other members of the genus *Aythya.*

Clutch size of most gulls and terns is 3 eggs at lower latitudes (Palmer, 1941; Tinbergen, 1961). Clutches of 3 eggs were rare, however, in Herring and California Gulls, and clutch size averaged 1.8 and 1.9, respectively (Table 6). No clutch of 3 was found in a sample of 90 nests of Arctic Terns. Although some may still have been laying, several nests were hatching, and other empty nests with nervous adults nearby suggested that hatching was well underway. Andersen (1959) found that only 9% of clutches of Arctic Terns were of 3 eggs at 55°53′ N. lat. in Denmark, but 75% of Common Tern clutches there were of 3. Arctic Tern clutches of only 1 and 2, however, were found in East Greenland at 73 to 75° N. lat. At least in the survey year, only clutches of 1 and 2 were found at 62° N. lat. on Great Slave Lake islands. The influence of land mass size on clutch size cannot be ignored, but we have no data on Arctic Tern populations not nesting on islands.

Nest-sites and cover plants

All gull and tern nests were open ground – either barren rock or moss tundra. Those on rocks usually had a bowl constructed of grass, moss or lichen, but a few tern nests were in a bare rocky depression. Those on the tundra mat usually were only a slight depression, but rarely did they have any significant amount of nest material (Figure 5).

Gulls were the only species to utilize small barren rocky islands free even of grass. Parasitic Jaegers selected high barren spots on the islands; rarely did other birds nest near them.

Nests of Savannah and White-crowned Sparrows were in tufts of grass in small cracks in the rock.

Cover type was recorded for 36 nests of Greater Scaup (Table 7). Most nests were in grass of the previous year's growth. Often they were in a crack

FIGURE 6. Nest of Greater Scaup in small patch of *Calamagrostis* sp.

in a rock (Figure 6) or near the edge of water (Figure 7). On the West Mirage Islands, however, nests were placed at various distances from water (range 1 to 50 feet, mean of 19 feet for 28 nests) and various heights above the water. The height varied with island height but nests were found at the tops of the highest islands as shown by a range of height estimates from 0 to 25 with a mean of 7 feet for 29 nests. Two Greater Scaup nests were in grass with an

TABLE 7. — Cover plants of 36 Greater Scaup nests on Great Slave Lake islands

	West Mirage Islands	Shoreward Islands	All nests
Calamagrostis sp.	13	3	16
Agrostis sp.	4	0	4
Poa sp.	1	1	2
"Dead grass"	3	0	3
Grass + willow	2	0	2
Grass + sedge	2	0	2
Carex spp.	1	1	2
Grass + yarrow	0	2	2
Ribes sp. + grass	1	0	1
Labrador Tea	1	0	1
Spruce branches	0	1	1
	28	8	36

FIGURE 7. Site of a Greater Scaup nest at the water level.

overhanging shrub; one was in gooseberry, and the other was in Labrador Tea. One nest was under the prostrate bough of a spruce tree, but most were in open sites that allowed good visibility and easy escape to water. Scaup nested on both wooded and unwooded islands but most utilized the latter.

Red-breasted Mergansers invariably were in dense shrubbery. In 4 instances, the nests were in the ground level boughs of spruce (Figure 4), but one was under a rock partly sheltered by *Ribes* sp., and one was in Labrador Tea. The last nest was near Greater Scaup and Pintail nests and had been parasitized by a Greater Scaup.

Species associations during nesting

The tendency of ducks to be associated in nesting with gulls and terns is well documented in Scandinavia (Koskimies, 1957; Hilden, 1964) and North America (Vermeer, 1968). Many of the islands studied in the Great Slave Lake did seem to have a large number of duck nests associated with tern colonies. An attempt was made to measure such interspecific relationships in nesting. One analysis compares species found nesting on the same islands of the West Mirage group (Figure 9). Greater Scaup and Arctic Terns were associated in nesting with nearly all other species, possibly because of their abundance or because of their adaptability to parts of most islands. California Gulls tended more to dominate barren islands and only Herring Gulls and Greater Scaup were found with them on the same islands. One broody pair of Arctic Terns was found on one island where California Gulls nested, but this

FIGURE 8. One of the larger pools, showing areas of grasses and sedges.

association seemed rare. Numbers of nests of Parasitic Jaegers and Caspian Terns were too few to be of significance.

Figure 9 also demonstrates intraspecific nesting associations by showing islands on which more than one nest of the same species was found. Parasitic Jaegers seemed to dominate islands on which they nested, and pairs may be mutually exclusive.

Table 1 on frequency of nesting by islands also suggests species associations. Greater Scaup nested on 22 of 73 West Mirage islands and 2 of the 7 shoreward islands. Of the 22 West Mirage Islands, 8 (36%) also had nesting Arctic Terns, 8 (36%) had California Gulls, and 5 (23%) had Herring Gulls. In total, some species of gull, tern or jaeger nested on 18 of the 22 (82%) islands. This does suggest a strong association, but there were islands used by gulls and terns on which Greater Scaup did not nest; 15 of the 73 (20%) West Mirage Islands and 3 of 7 (43%) offshore islands examined had nests of gulls or terns but none of scaup.

A third attempt to show species interactions is Figure 10, which indicates species observed (rather than nesting) on the same island. This measure shows better than does Figure 9 the universal abundance of Savannah Sparrows. The diverse interactions of less common species such as Mew Gulls and Song Sparrows merely reflects the occurrence of one species on a large island used by many. In other words, the island size and habitat conditions were of greater significance than species competition or other interactions.

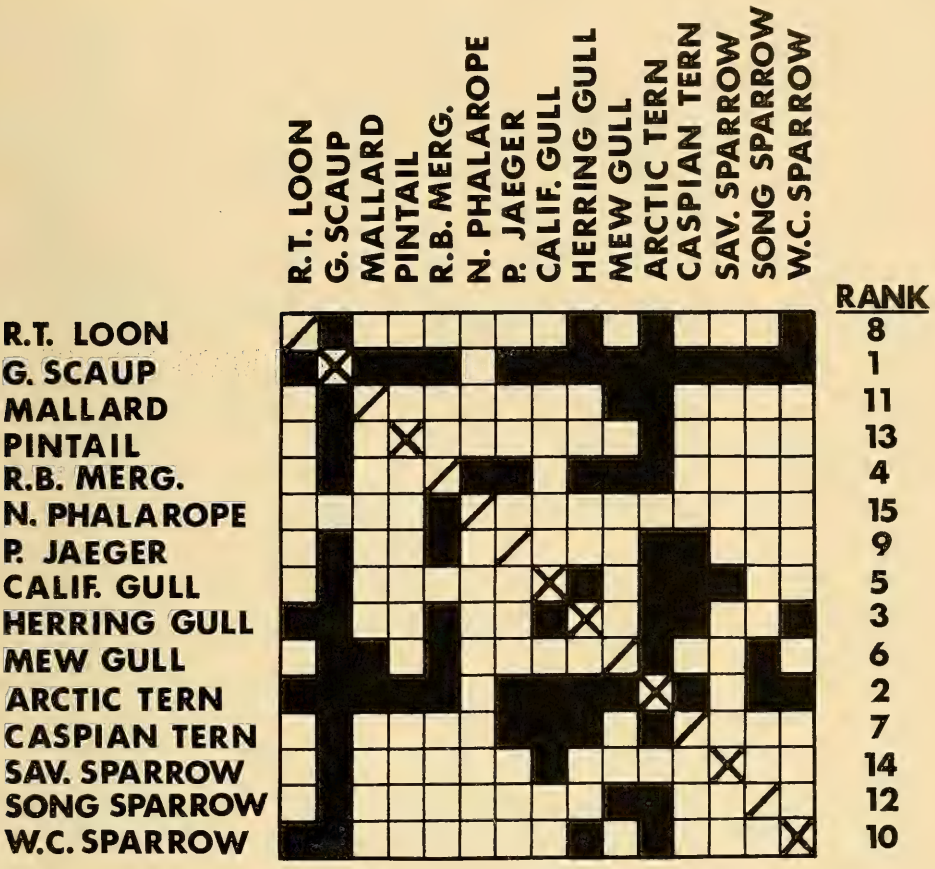

FIGURE 9. Interspecific relationships of species as shown by species found nesting on the same island.

Species diversity and island size

The diversity of birds on any land mass seems generally more directly related to the size of that mass than to distance from the mainland source of pioneers (MacArthur and Wilson, 1967: 20-23). Because the West Mirage Islands form a tight cluster, distance to mainland was not analyzed. But an analysis of relative area of islands and breeding birds was made (Figure 11). The resulting plot provided only a suggestion of an increase in numbers of breeding birds with increased area but a stronger relationship exists between species of birds sighted and area of the islands. Unfortunately, sample size of larger islands was small (see data on frequency of occurrences in Figure 11).

In general, larger land masses have greater habitat diversity, and presumably this is the cause of the larger number of avian species. An effort was made to compare wooded and nonwooded islands of equal size but the sample sizes of large unwooded islands and small wooded islands were small. In the

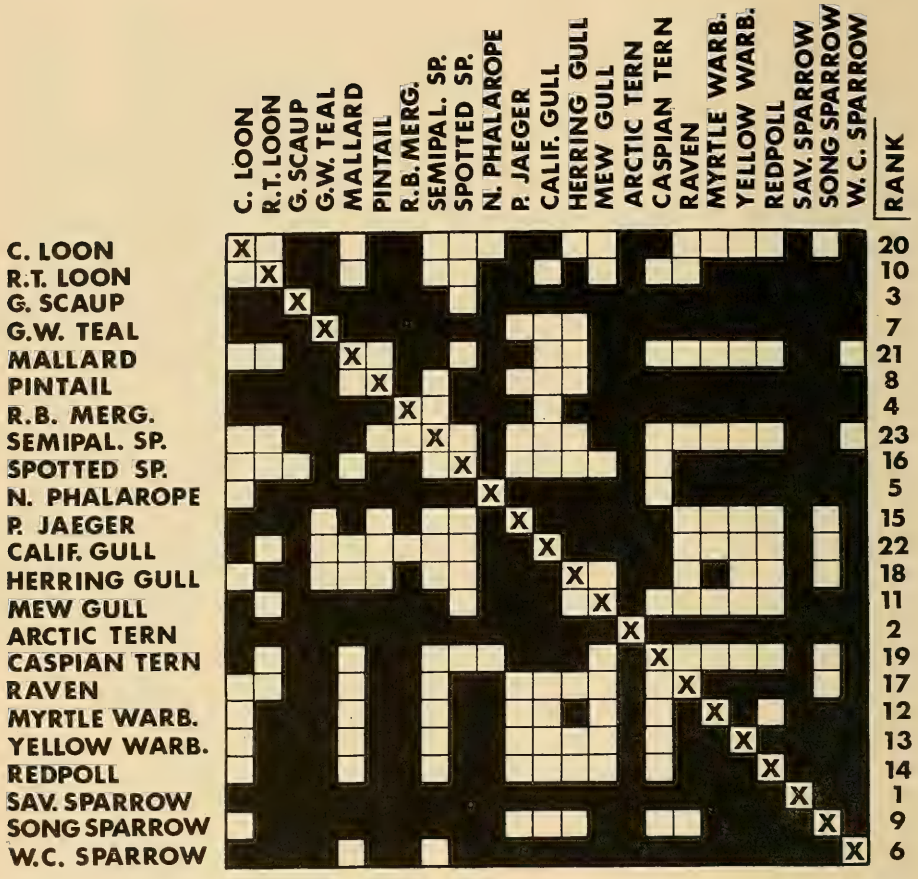

FIGURE 10. Interspecific relationships of birds as shown by species sighted on the same island.

smaller islands, the diversity induced by the presence of trees seemed to reduce bird use, but a positive relationship was obvious on larger islands (Table 8). This may be due to the dominance of ground-nesting birds and their need of

TABLE 8. — Relative importance of habitat in the species-area relationship

	Relative Isl. size in acres	No. Isl.	Mean no. breeding per island	Mean no. sighted per island
Non-wooded	3–5	23	1.3	1.8
Wooded	3–5	7	0.4	1.1
Non-wooded	5–16	5	2.2	4.0
Wooded	5–16	4	2.5	5.8

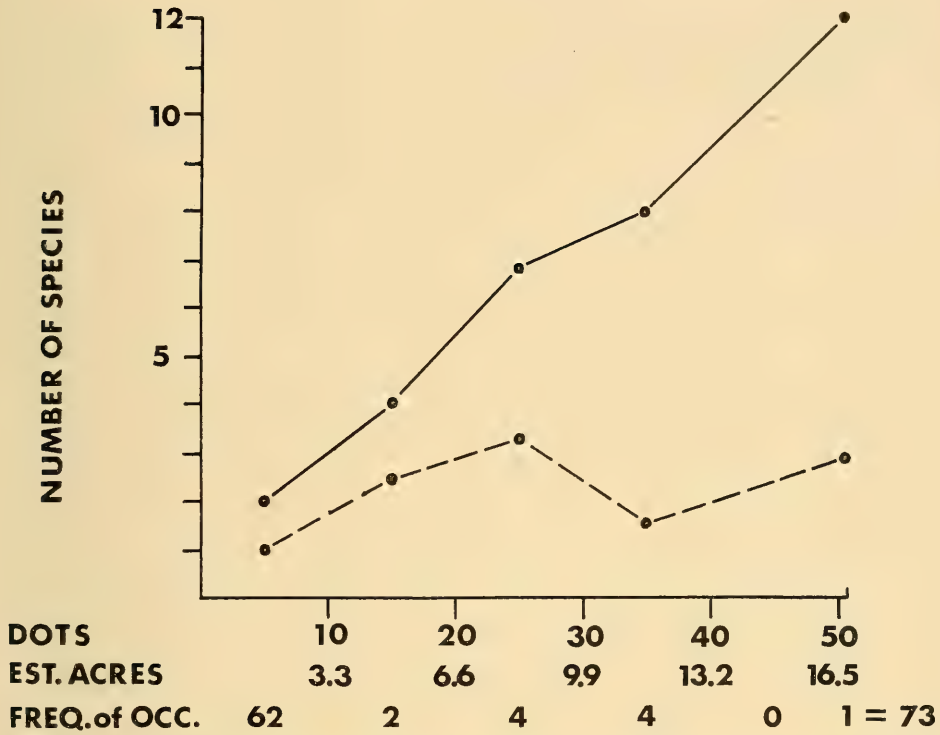

FIGURE 11. Area-diversity pattern for birds observed and possibly nesting on the West Mirage Islands.

open areas; i.e., trees were a deterrent to ground-nesting birds on small islands but not on larger islands where relatively larger open spaces existed.

Most breeding birds of these islands were ground-nesting species utilizing fish rather than foods associated with land. Undoubtedly, population size and species diversity both were increased markedly by this addition to the habitat.

ACKNOWLEDGMENTS

We are indebted to Mr. William McDonald, geologist and long-term resident of Yellowknife, who inspired an interest in the Great Slave Lake islands and who guided us to the offshore and West Mirage Islands. Both Trauger and Krapu were employed by the Northern Prairie Wildlife Research Center, Bureau of Sport Fisheries and Wildlife, and were engaged on studies of Lesser Scaup and other species on the mainland. Mr. Charles E. O'Brien of the American Museum of Natural History kindly identified some bird remains.

SUMMARY

The breeding birds of 73 of 97 islands of this isolated group were studied on June 30 and July 3-5, 1968. Their location in a cold, deep lake produced a harsh environment and results in vegetation comparable to that 100 miles or

more northward of these islands. Evidence of 35 species of birds was recorded of which 17 were observed nesting or caring for young. The species found on the island were characteristically widespread and adaptable birds and most were ground-nesting species. Sightings and nests found indicated an order of abundance for the 5 major species as follows: California Gull, Arctic Tern, Savannah Sparrow, Herring Gull, and Greater Scaup.

Most of the gulls and terns were colonial nesters and used only a few islands. Solitary nesters such as Greater Scaup and Savannah Sparrows were found on nearly every island. Clutch size of most gulls and terns was nearer 2 than 3, supporting observations on the relationship of clutch size and latitude observed in Scandinavia. Clutch size of Greater Scaup varied from 1 to 22 with several large clutches denoting intraspecific parasitism.

Most birds were ground-nesters and had relatively exposed nests. Greater Scaup and the sparrows, however, used grassy depressions or cracks in the rocks. Red-breasted Mergansers placed their nests under shrubs or at the bases of spruce trees. Few tree-nesting species were present, and only one Bald Eagle nest was found in a tree.

An analysis of species interactions shows a strong association between ducks and gulls. Large islands with greater habitat diversity tended to have the greatest diversity of bird species. Aquatic food resource surrounding the islands undoubtedly permitted larger populations and greater diversity of birds than on an equal land area.

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OBSERVATIONS ON CANADIAN BIRCH (*BETULA*) COLLECTIONS AT THE MORGAN ARBORETUM. VIII. *BETULA* FROM GRAND MANAN ISLAND, NEW BRUNSWICK

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A collection of birch specimens was made by the senior author on Grand Manan Island (Long. 65°45′ West, Lat. 44°40′ North) situated in Charlotte County, New Brunswick, at the entrance to the Bay of Fundy, a distance of six miles from West Quoddy Head, Maine. It was anticipated that an intensive study of individuals from one rather isolated area might provide greater information on the relationships between species and also provide data which could be used in a comparison of populations from other areas of Canada.

In addition to *B. cordifolia* Regel, *B. papyrifera* Marsh., and *B. populifolia* Marsh., a number of trees similar to those described by Blanchard (1904a,b) as "Blue Birches" (*B. caerulea* Blanch. and *B. caerulea-grandis* Blanch.) were found. The former species, *B. caerulea*, is considered to be a hybrid between *B. populifolia* and *B. papyrifera* (Fernald, 1945, 1950) and it has been speculated that the latter species, *B. caerulea-grandis*, is also a hybrid between these two species (Brayshaw, 1966). However, data to be presented suggests that *B. cordifolia* plays a role in the origin of the blue birches and the relationships of these species to each other will be considered here.

Materials and Methods

The Site

Weatherby and Adams (1945) in a check list of the species growing on Grand Manan Island present an outline of the physiography, geology, and forest growth of the island, and remark on the alterations that have occurred over the years as a result of human interference. This aspect is of particular significance since it indicates the radical change that has occurred from the original conditions existing at the time of settlement. In 1839, Gerner (Weatherby and Adams, *l.c.*) is quoted as stating that the hilly area was covered with a fine growth of beech, birch, and maple, whereas the lower lands had an immense growth of pine and spruce, adding that the largest growth had been destroyed by fire. Mention is also made of the destructive fire which swept the island in the late nineteenth century, which must have destroyed most of the then existing leaf mould. In 1945, Weatherby and Adams (*l.c.*) attributed lumbering activities for the great change in the vegetative aspect of the island since their previous visit in 1929. It seems clear that these changes have greatly accelerated since 1945 and it is now known that lumbering in the interior of the island was not completed until 1966. This has left behind

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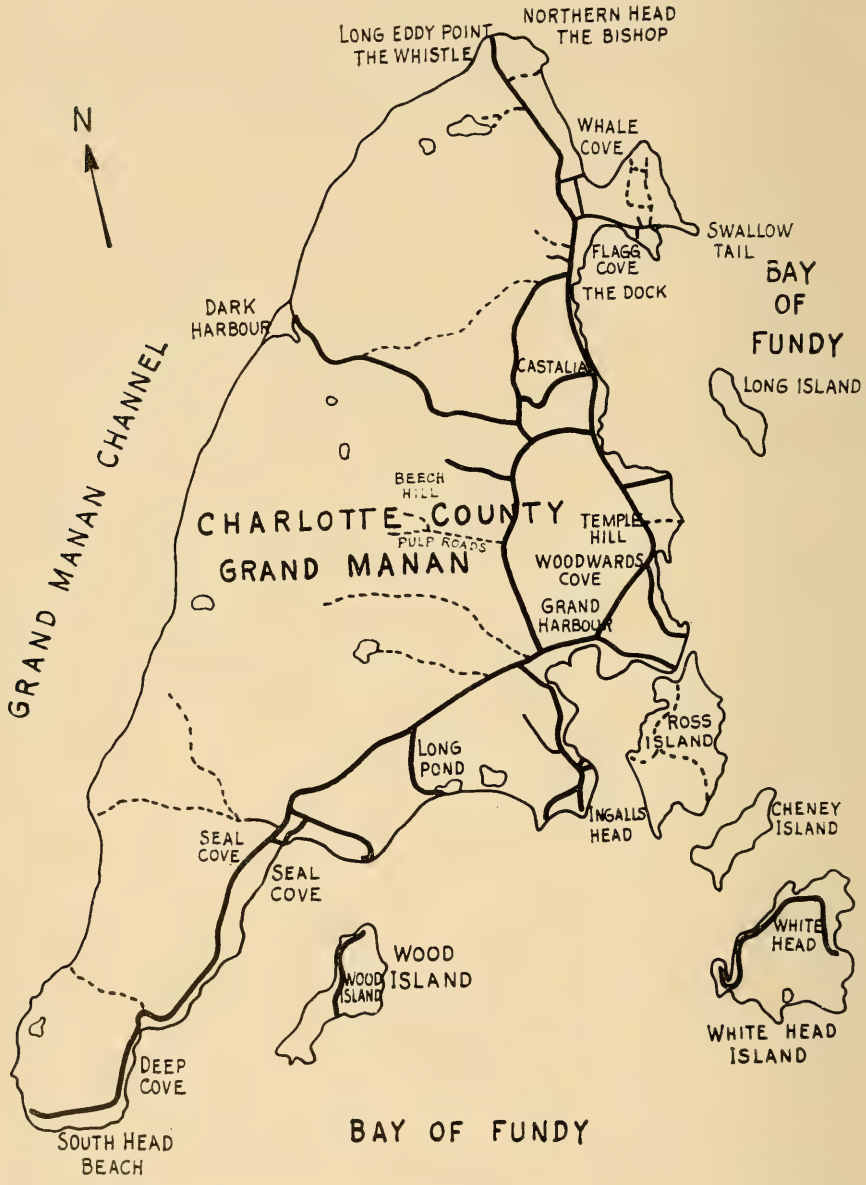

FIGURE 1. Map of Grand Manan Island, New Brunswick, showing principle roads (see text).

isolated individual trees, or clumps, of *B. cordifolia* up to 45 years of age, and some older growth of *B. alleghaniensis.*

Collecting Stations

The map of the island (Figure 1) lists the names of the major collecting stations that are situated on the main road that runs the length of the island

FIGURE 2. Detailed map of Anchorage Road showing the two main collecting stations marked *A* and *B* (see text).

and from which run short cross roads extending into the various coves. Some collecting was also carried out along the "pulp roads" which extend from the Hill Road, that runs roughly parallel to the main road into the hilly interior, and along the Dark Habour Road crossing the island from Castalea. It is in the former area that recent destructive cutting has occurred, and there has not been time for a second growth to take possession of this area.

While collections were made at random over the island, attention was concentrated on two areas marked A and B in Figure 2. The former was a low lying area where the present cover has grown up after a considerable cutting

some 35 years before which involved a much larger acreage. The greater part of the plant population was furnished by birch species. In the moister part of this area there was a dense undergrowth of *Spiraea latifolia* and *Alnus rugosa* (*A. incana*), with a scattering of other species as follows: *Fraxinus nigra*, *Sambucus pubens*, *Salix* sp., *Viburnum cassinoides*, *Picea rubens*, *Prunus virginiana* and *Larix laricina*.

Area B is situated on rising ground and underlaid by rock. It represents a narrow cut-back from the prevailing spruce–fir woods at the back. The depth of the cutting is approximately 45 metres which was made some 12 years ago. It is covered by a scattering of *B. cordifolia* trees, and the older individuals have attained a diameter up to 4 cm and are already bearing seed. A few small *B. populifolia*, less than a metre high, were noted. There was an abundance of small red spruce and balsam seedlings in from the woods at the back. There was also an irregular fringe of large *B. cordifolia* trees fronting the woods, and this was the predominant birch species in area B. This area, in a sense, represents an earlier stage of development than area A, though spruce and fir will ultimately loom larger in this complex than in area A.

Weatherby and Adams (1945) listed only *B. papyrifera* and *B. populifolia* from Grand Manan. However, Hodgdon and Pike (1962, 1964) reported collecting *B. papyrifera* var. *cordifolia* (Regel) Fern,. and in this paper the presence of *B. caerulea* and *B. caerulea-grandis* on Grand Manan Island is reported for the first time.

The Climate

In a soil survey of southwestern New Brunskick, Wicklund and Langmaid (1953) provided some climatic data which is of value in understanding the present ecological relationship of the species on the island. Birches are particularly sensitive to temperature and water levels. The Grand Manan climate is noted for cool summers, mild winters, and a greater number of frost-free days (177 days) than some coastal areas such as St. John, New Brunswick (169 days). The average mean temperature for the four winter months, December–March, is –2.2, –4.4, –5.0, –1.1°C, respectively, as compared with Fredericton, N.B. –7.2, –10.0, –9.4, and –3.3°C, respectively. Similarly, the average mean temperature for the actual growing period, May–August, for Grand Manan is 8.8, 13.3, 16.6, and 16.6°C, respectively, while for Fredericton, for the same period, it is 10.5, 15.6, 18.9 and 4.4°C, respectively. The amount of rainfall is only slightly different between these two areas, 23.86 cm for the period April—October for Grand Manan, and 24.99 cm for Fredericton. These figures for total rainfall, however, do not tell the whole story, since the great prevalence of ocean fogs which occur in Grand Manan have the effect of greatly depressing the evaporation rate.

Criteria Used in the Analysis

The characters used in distinguishing the species are as follows:

1. Leaf Attenuation Factor. This is expressed as the a/m ratio (Brayshaw, 1966) where a equals one-half the apical segment, that is, the distance from

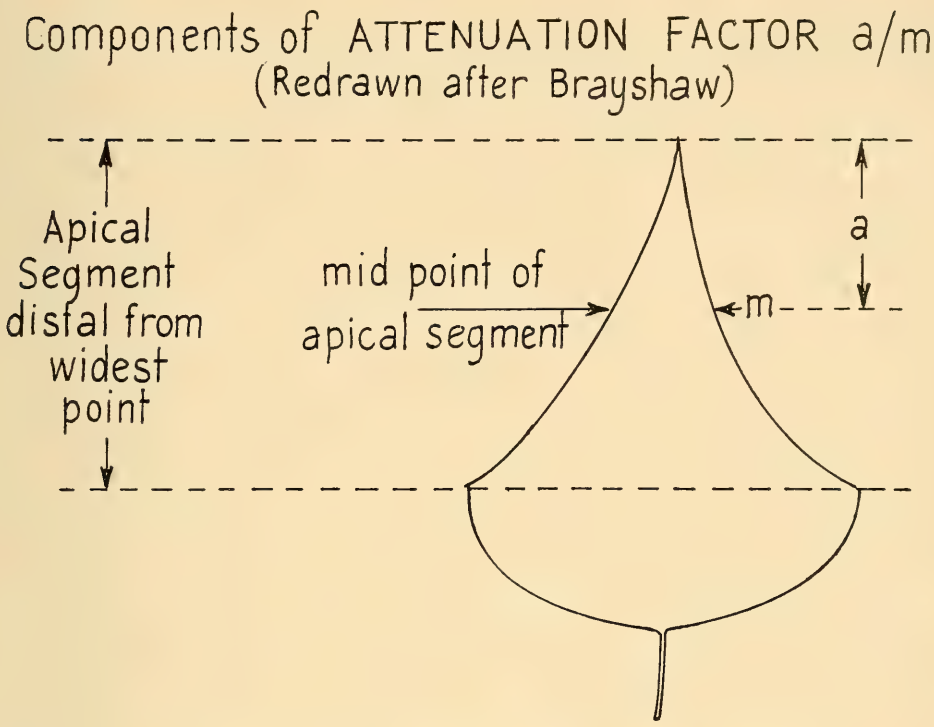

FIGURE 3. Diagram illustrating the method for determining the leaf attenuation factor *a/m*.

the widest part of the leaf blade to the leaf tip, and *m* equals the width of the leaf blade at the midpoint of the apical segment (Figure 3, redrawn from Brayshaw, 1966). Five leaves per specimen were measured but for comparative purposes only from catkin bearing shoots.

2. Leaf base. The leaf base was considered under four forms: a) mainly cuneate, b) shortly rounded or truncate, c) cuneate and cordate mixed, and d) mainly cordate.

3. Leaf lateral veins. The number of lateral veins on one side of a leaf. A minimum of five leaves were used for each accession.

4. Leaf serrations. The number of serrations on one side of a leaf. A minimum of five leaves were used for each accession.

5. Stomatal guard cells. A minimum of twenty guard cells were measured for each accession.

6. Catkin length. Five mature catkins were measured for each accession.

7. Style length. Five to twenty styles were measured for each accession.

8. Achene length and width. Five to twenty achenes were measured for each accession.

9. Achene length-width (L/W) ratio. The ratio between the length and width of the achene.

10. Bract length. Five to twenty bracts were measured for each accession.

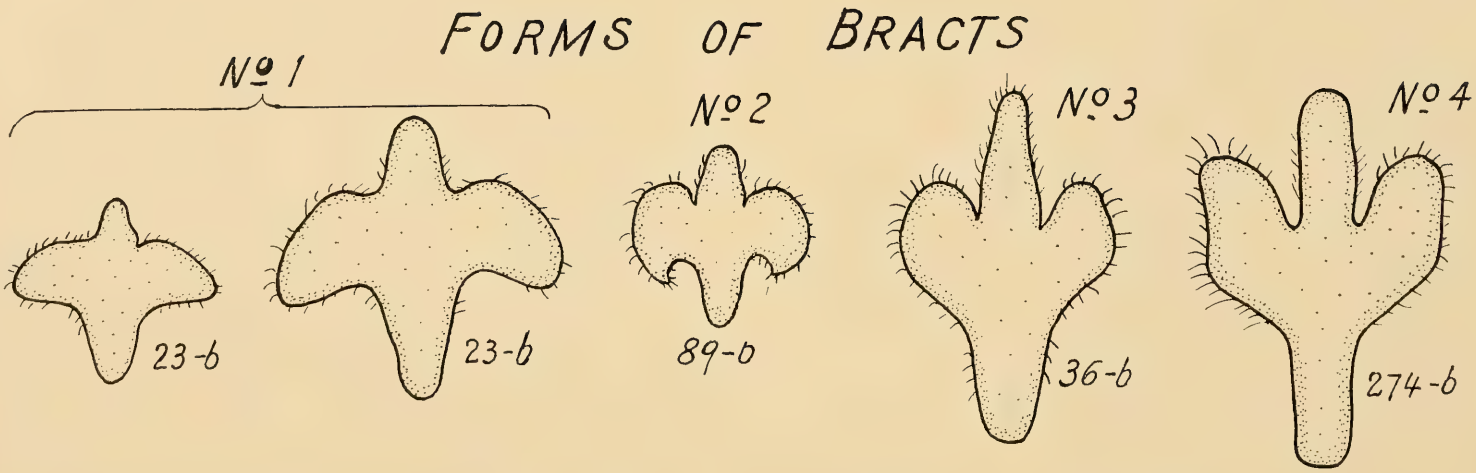

FIGURE 4. Outlines of bracts to illustrate the four types of fract form. Accession number 23 is *B. populifolia;* 89, *B. caerulea;* 36, *B. papyrifera;* 274, *B. cordifolia.*

11. Bract form. Four distinct types of bract form were recognized (Figure 4): Form 1. Lateral lobes extending horizontally or only slightly downcurved. Form 2. Lateral lobes sharply recurved, median lobe tapering. Form 3. Lateral lobes porrect, medium lobe tapering. Form 4. Lateral lobes always porrect, medium lobe with subparallel sides.

12. Chromosome number determinations. Our techniques have been given previously (Brittain and Grant, 1965a).

In order to help determine the relationships of the taxa under study, a) hybrid indices, b) pictorialized scatter diagrams, and c) polygonal graphs, were constructed as follows:

a) Hybrid index. The hybrid index is a means of analyzing the variation in a natural population and illustrating visually the presence or absence of hybridization within the population (Anderson, 1949, 1953). A character which varies in the population may be assigned a value such as zero, one, or two depending on the number of arbitrarily chosen variations of the character. In this study, characters associated with one parent were rated as zero, whereas those associated with the other parent were rated as two. Intermediate situations were assigned the value of one. When this type of rating is carried out for a number of characters then the members of one of the two parental populations would have a total or hybrid index value of zero even if we assume eight characters were used, as in the populations studied. The other parental population, with a value of two for each character, would have a hybrid index value of sixteen for the eight characters. The characters used and the hybrid index values assigned to them are listed in Table 2.

The hybrid index values were arbitrarily obtained by subtracting the standard deviation from the mean for the parent with the highest mean value and adding the standard deviation to the mean for the parent with the lowest mean value. The resulting figures were used for the range of the intermediate values and assigned a hybrid index value of one. For example, the mean catkin length of *B. cordifolia* was 4.05 cm and the standard deviation 0.62 $(4.05 - 0.62) = 3.43$. Likewise, for *B. papyrifera*, 3.10 ± 0.59 $(3.10 + 0.59) = 3.69$. Zero represented values lower than 3.43, whereas two represented values higher than 3.69 (see Tables 1, 2).

Bar graphs were constructed plotting hybrid index values against the frequency with which they occur in the population. A visual indication of the absence, or presence, of hybridization, the degree of hybridization, the direction in which hybridization and backcrossing is occurring between species, may be obtained from this procedure.

b) Pictorialized scatter diagrams. This method of population analysis (Anderson, 1949) has been used to illustrate character-association and the effects of hybridization in a natural population. The relationship between two birch characters was plotted for each specimen in a two-dimensional field. Each spot or circle in the field represents one specimen. The circles were then modified to include the analysis of additional characters simultaneously by means of appending lines at 12, 3, 6, and 9 o'clock. The association of several characters may be observed and the effect of hybridization on this association

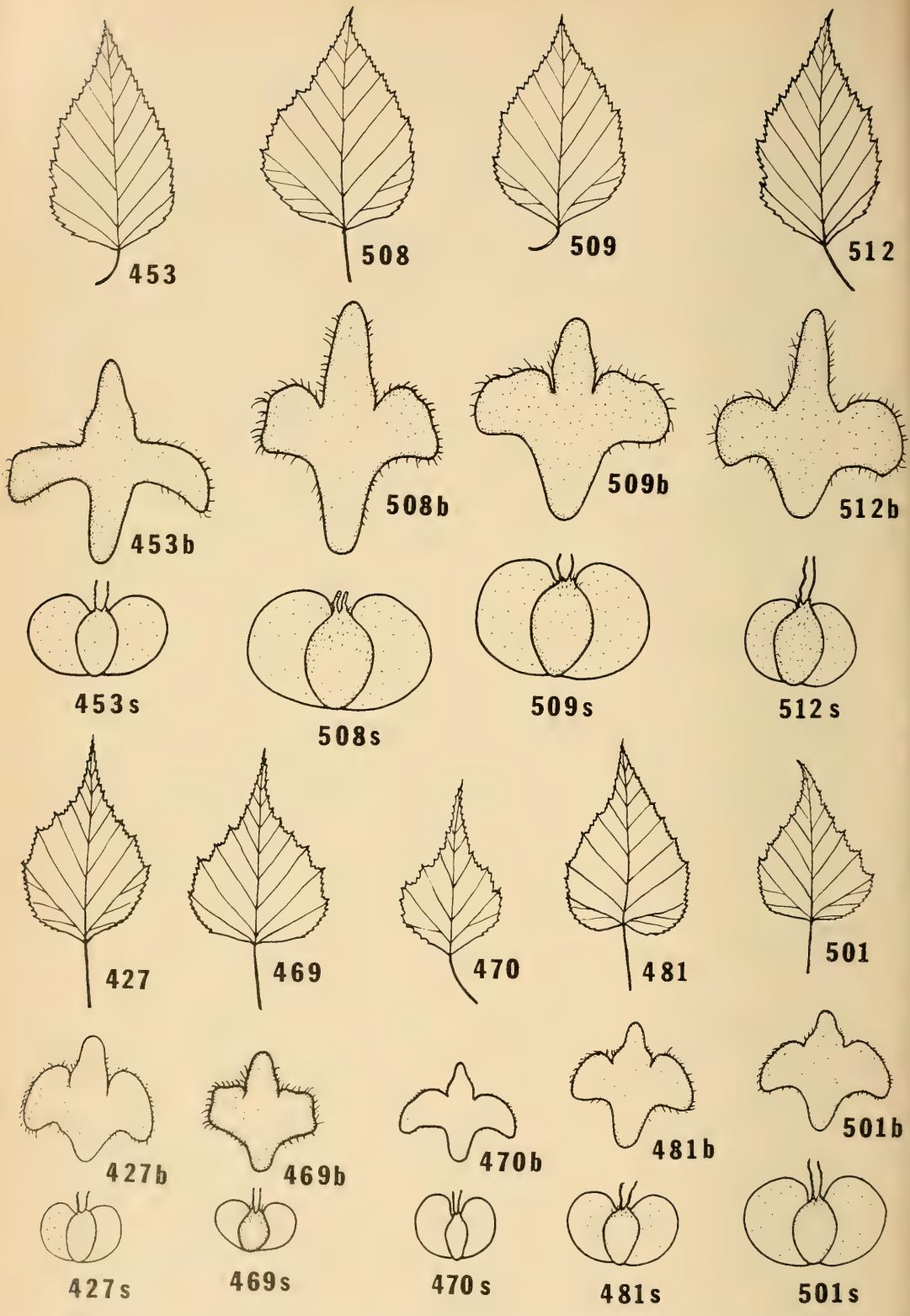

FIGURE 5. Representative illustrations of leaves (reduced ca. 3/5) and bracts and samaras × ca. 6) of *B. papyrifera* (upper half, accession numbers 453, 508, 509, 512) and *B. populifolia* (lower half, accession numbers 427, 469, 470, 481, 501). b = bract; s = samara.

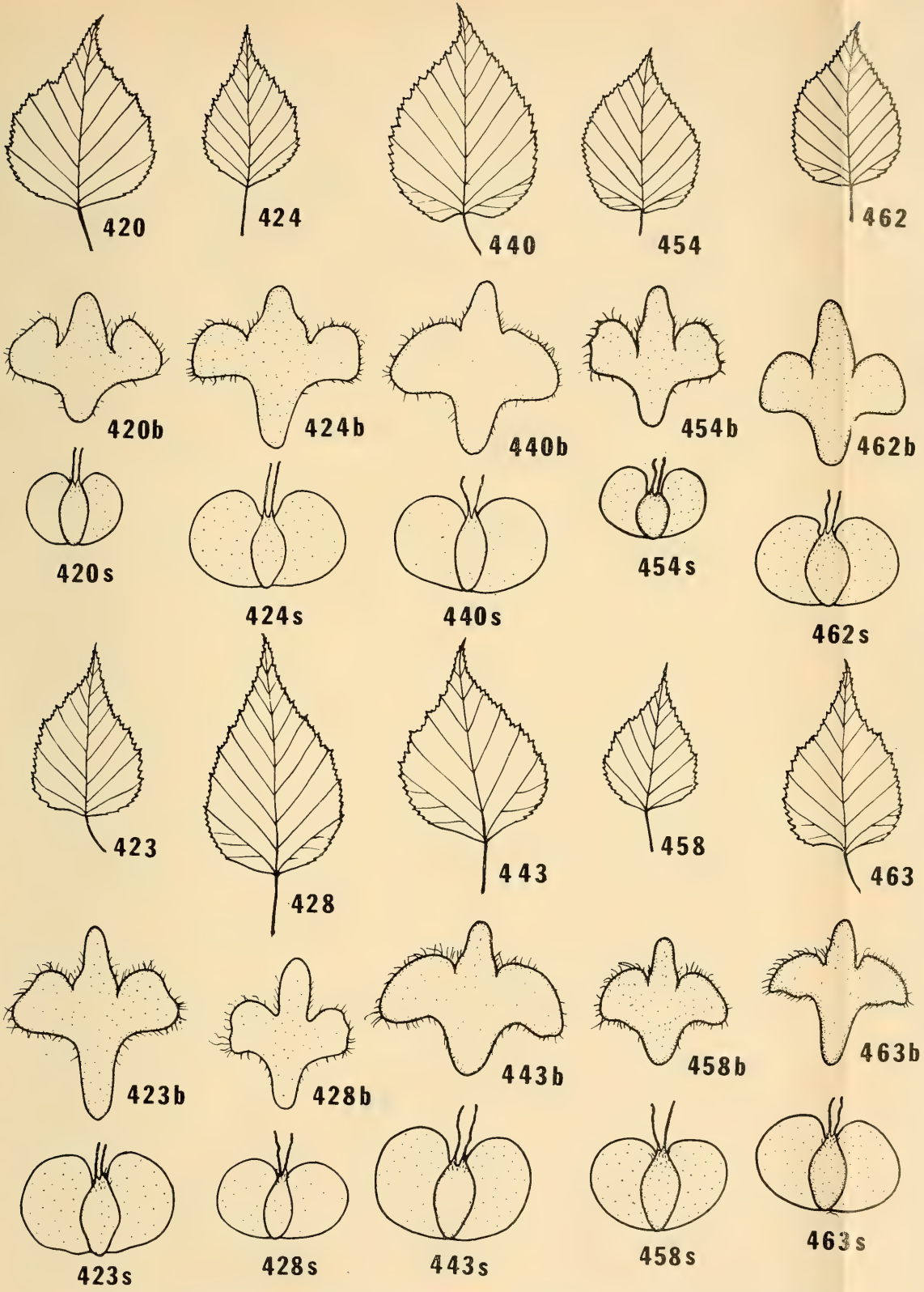

FIGURE 6. Representative illustrations of leaves (reduced ca. 3/5) and bracts and samaras × ca. 6) of *B. caerulea*. The numbers refer to accession numbers. b = bract; s = samara.

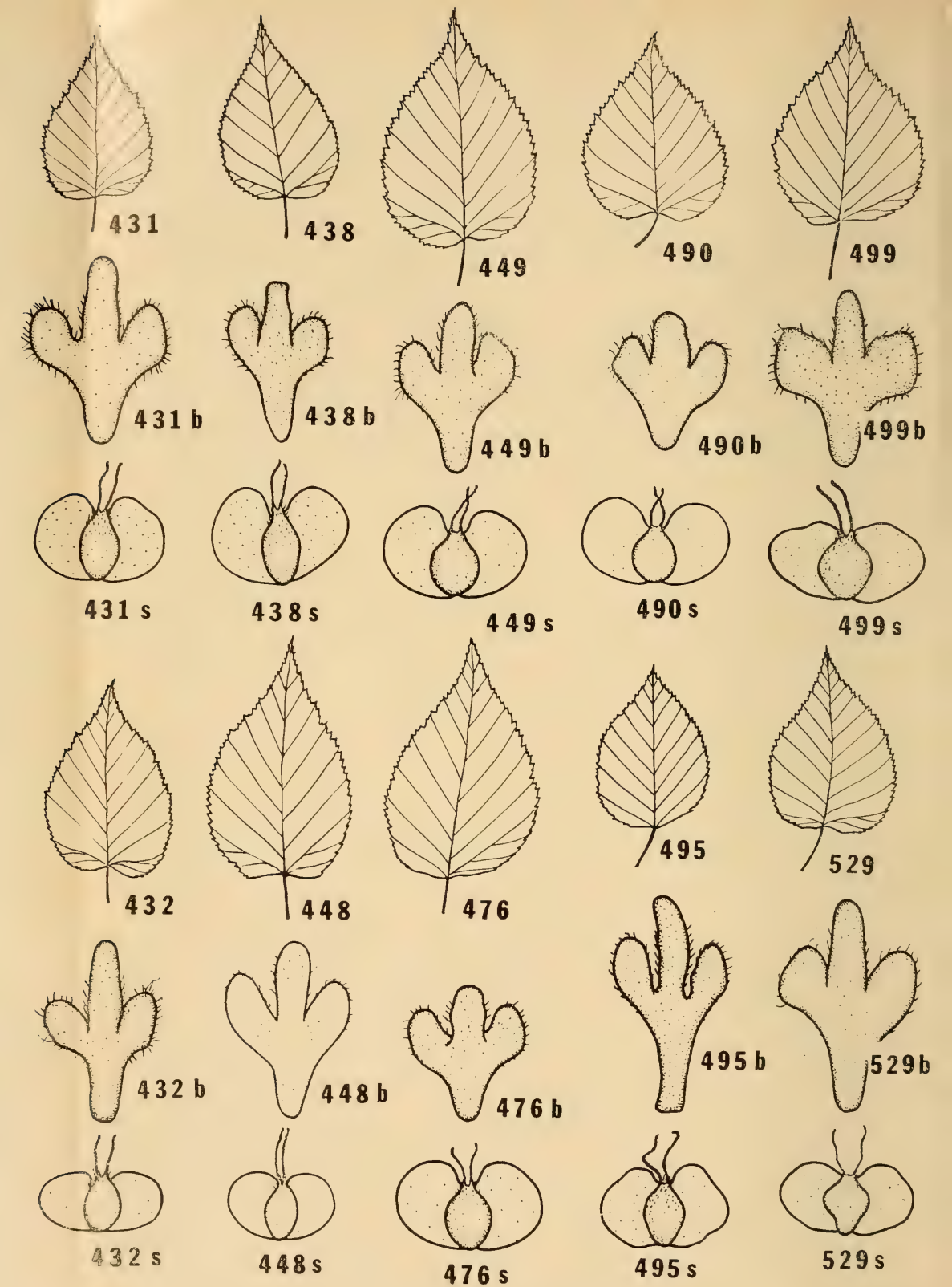

FIGURE 7. Representative illustrations of leaves (reduced ca. 3/5) and bracts and samaras × ca. 6) of *B. cordifolia*. The numbers refer to accession numbers. b = bract; s = samara.

if hybridization has occurred.

c) Polygonal graphs. The polygonal graph is a circle with as many radii as characters under consideration. The units on each radius represent measurements of one character. Each accession number is represented by the mean measurements of the characters being plotted. Since each measurement is plotted along a different radius, when all the points representing the measurements of one individual are plotted and joined together, a polygon is formed. This permits the visual comparison of members of a population on the basis of several characters at the same time.

Other characters than the foregoing might well have been used but it was found that those selected were sufficient for the purpose of establishing the identity of our specimens. Some characters such as bark color could not be used, because many of the trees from which we obtained catkins still maintained their juvenile character in respect to bark color, or evidenced the loose exfoliation characteristic of older trees.

In statistical analyses which were carried out, the standard deviation of the individual mean to the mean of the species was calculated for the nine morphological characters given in Table 1. The mean values for each species were subjected to a *t* test employing an IBM computer to determine if the means were significantly different.

OBSERVATIONS AND DISCUSSION

Chromosome numbers were determined from root tips of young seedlings for 38 collections of *B. cordifolia*, 30 of *B. caerulea* and 6 of *B. populifolia*. All seedlings of these taxa had a somatic chromosome number of 28. In contrast, seedlings of 15 of the 17 collections of *B. papyrifera* had 84 somatic chromosomes and the remaining two 70. There was a greater number of 84-chromosome plants in the Grand Manan collection than in collections from other areas, where there were more individuals with 70 chromosomes (Brittain and Grant, 1967). Likewise in the Grand Manan collection, no seedlings of *B. papyrifera* were found with 56 somatic chromosomes.

Drawings of leaves and fruit characters have been chosen to illustrate the extremes in morphological variability found for each species (*B. papyrifera* and *B. populifolia*, Figure 5; *B. caerulea*, Figure 6; *B. cordifolia*, Figure 7).

The means and standard errors for the measurements of the morphological characters are given in Table 1. The results of the *t* tests have been indicated by appending letters to the means. Those means which do not differ significantly from one another are followed by the same letter. For example, the means of the achene length for *B. papyrifera*, *B. populifolia*, *B. caerulea* and *B. cordifolia* are followed by the letters a, b, a, and c, respectively. This signifies that the difference in the length of the achene between *B. papyrifera* and *B. caerulea* is not significant; other combinations are significant. It may be seen that each species differs significantly from the other three species for four characters (catkin length, bract length, achene width, and style length), and that each species differs significantly from two of the four species for three additional characters (achene length, leaf *a/m* ratio, and guard cell length).

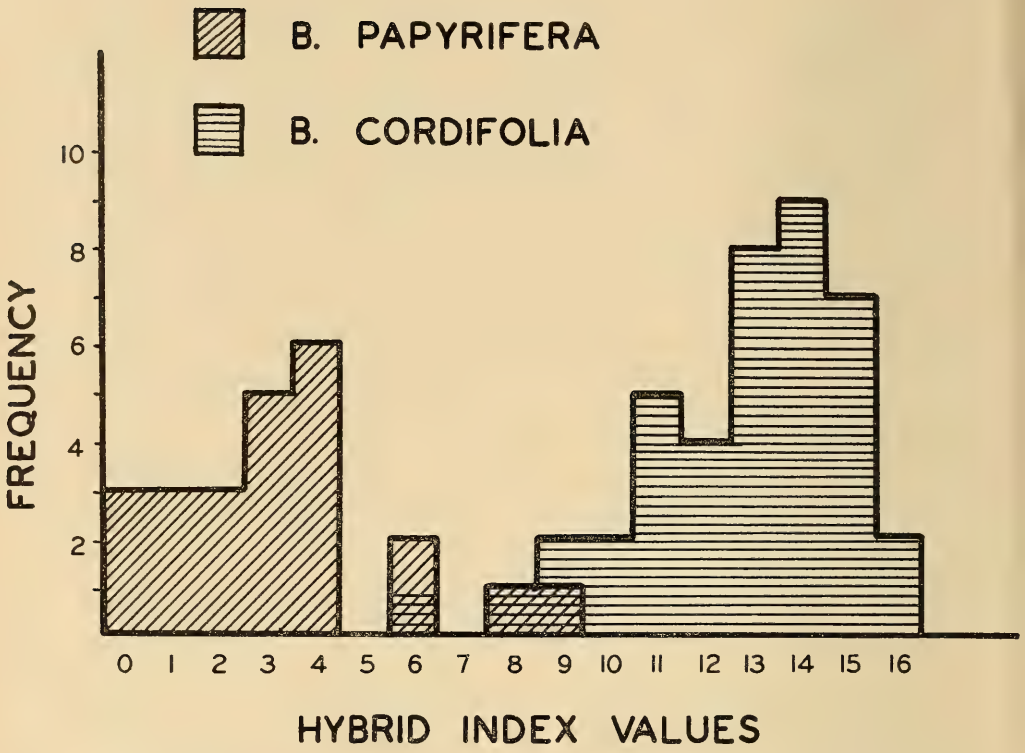

FIGURE 8. Frequency of hybrid index values of *B. papyrifera and B. cordifolia.*

Comparison of B. papyrifera *and* B. cordifolia

The specimens from Grand Manan have made it possible to compare these taxa from a relatively restricted area. A hybrid index for eight measurable characters was prepared (Table 2) and a bar graph based on the hybrid index values for each specimen is shown in Figure 8.

The hybrid index of a typical *B. papyrifera* ranged from 0 to 4 whereas that of *B. cordifolia* ranged from 10 to 16. In general, individuals of these two taxa were clearly distinct from one another; however, two individuals of *B. papyrifera* with hybrid index values of 8 and 9 fell in the range of *B. cordifolia* and one specimen of *B. cordifolia* with a hybrid index value of 6 overlapped with those of *B. papyrifera.* A few specimens of *B. papyrifera* found elsewhere in eastern Canada (Brittain and Grant, 1967) had 56 somatic chromosomes and had certain hybrid characteristics. However, the specimens studied here with intermediate hybrid index values had the same chromosome numbers as those found for the typical species.

In the pictorialized scatter diagram (Figure 9), measurements of the style length and guard cell length were plotted for each individual. It may be seen that *B. cordifolia* and *B. papyrifera* are clearly distinct from one another. The individual of *B. papyrifera* with a hybrid index value of 9 (No. 450) was close

TABLE 1. — Measurements for the morphological characteristics of birch species from Grand Manan Island. Mean and standard error are given for each character with range in brackets

Character	*B. papyrifera*	*B. populifolia*	*B. caerulea*	*B. cordifolia*
Catkin length (cm)	3.16±0.12 a* (2.00—4.40)	1.91±0.05 b (1.46—2.58)	2.72±0.08 c (1.52—3.75)	4.05±0.10 d (3.13—5.68)
Bract length (mm)	5.23±0.16 a (4.08—7.00)	3.47±0.07 b (2.71—4.56)	4.53±0.09 c (3.50—6.00)	5.99±0.16 d (4.58—9.10)
Achene length (mm)	1.97±0.03 a (1.60—2.92)	1.60±0.03 b (1.32—2.00)	2.05±0.04 a (1.60—2.71)	2.34±0.04 c (1.76—2.70)
Achene width (mm)	1.31±0.03 a (1.01—1.57)	0.83±0.02 b (0.62—1.12)	1.08±0.02 c (0.83—1.36)	1.53±0.02 d (1.29—1.78)
Achene length/ width ratio	1.49±0.05 a (1.10—2.04)	1.94±0.05 b (1.38—2.53)	1.92±0.05 b (1.50—2.53)	1.53±0.02 a (1.26—1.83)
Style length (mm)	0.71±0.04 a (0.19—1.13)	0.92±0.03 b (0.60—1.44)	1.14±0.04 c (0.80—1.80)	1.46±0.05 d (1.00—2.37)
Leaf *a/m* ratio	0.91±0.03 a (0.68—1.16)	1.53±0.06 b (1.05—2.50)	1.26±0.04 c (0.93—1.73)	0.88±0.02 a*** (0.63—1.20)
No. of serrations	29.43±0.89 a (20.0—36.5)	40.52±1.70 b (28.4—87.2)	42.71±1.22 bc (30.4—63.6)	45.50±1.38 c*** (30.0—71.0)
Pairs of lateral veins	7.23±0.12 a (6.5—8.9)	7.25±0.11 a (5.6—8.6)	7.14±0.17 a (4.1—9.0)	8.68±0.14 b*** (6.6—10.4)
Guard cell length (μ)	36.27±0.72 a (28.20—44.46)	32.47±0.57 b** (28.48—35.01)	32.62±0.57 b (26.88—38.10)	30.36±0.37 c*** (25.59—37.00)
No. specimens examined	22	34	32	42

*a,b,c,d: Mean values between species are significant at 0.05 level except when means are followed by the same letter; see text.
**Mean based on 10 specimens.
***Mean based on 41 specimens.

to the boundary. Plants numbered 465 and 444 which lie in similar positions have a hybrid index value of 4 and 2, respectively. The individual of *B. cordifolia* (No. 525) with a hybrid index value of 8 was again adjacent to the boundary or intermediate in its relationship to specimens of both taxa. Specimens which fell on the extremes of the range, that is, number 448 of *B. cordifolia* and number 517 of *B. papyrifera* had hybrid index values of 15 and 2, respectively, characteristic of their respective taxa. For *B. cordifolia*, specimens numbered 497, 505, and 513 had a hybrid index value of 0, and for *B. papyrifera* specimens numbered 436 and 495 had a hybrid index value of 16.

Polygonal graphs based on eight selected characters were prepared for each plant analysed. The assigned values for these characters are given on the eight radii in the key to the polygons (Figure 10). Representative polygons illustrating the entire variation found for *B. cordifolia* and *B. papyrifera* are

shown in Figure 11. The polygons have been arranged to give a visual image of the morphological variation between individuals as revealed by this method. The upper four rows of polygons in Figure 11 are of *B. cordifolia* and the latter four are of *B. papyrifera*. The morphological variability which is evident in herbarium specimens of *B. papyrifera* is clearly exhibited in the polygons representing this species. In contrast, the polygons of *B. cordifolia* are considerably more uniform indicating the closer similarity in morphological features of representatives of this taxon.

Our analysis has shown that *B. cordifolia* (*B. papyrifera* var. *cordifolia*) is clearly distinct from *B. papyrifera* in chromosome number, in the pictorialized scatter analysis (Figure 9), and in the polygon analysis (Figure 11). An occasional specimen of *B. cordifolia*, or *B. papyrifera*, may have some characteristics which overlap with the other species as may be seen from a comparison of the hybrid index values (Figure 8) for these two species. However, with the exception of the achene length/width ratio and the leaf *a/m* ratio, the eight characters studied were all statistically significantly different (Table 1). This

TABLE 2. — Characters and index values used in scoring hybrid index for: *A*—*B. papyrifera* and *B. cordifolia*; *B* – *B. populifolia*, *B. caerulea* and *B. cordifolia*

1. Catkin length (cm)	< 3.42 = 0 3.43 – 3.69 = 1 > 3.7 = 2	< 2.17 = 0 2.18 – 3.43 = 1 > 3.44 = 2
2. Bract length (mm)	< 4.93 = 0 4.94 – 6.18 = 1 > 6.19 = 2	< 3.85 = 0 3.86 – 4.94 = 1 > 4.95 = 2
3. Achene length (mm)	< 2.10 = 0 2.11 – 2.30 = 1 > 2.31 = 2	< 1.76 = 0 1.77 – 2.11 = 1 > 2.12 = 2
4. Achene width (mm)	< 1.39 = 0 1.40 – 1.47 = 1 > 1.48 = 2	< 0.93 = 0 0.94 – 1.40 = 1 > 1.41 = 2
5. Style length (mm)	< 0.93 = 0 0.94 – 1.15 = 1 > 1.16 = 2	< 1.06 = 0 1.07 – 1.15 = 1 > 1.16 = 2
6. Number of serrations	< 33.97 = 0 33.98 – 36.63 = 1 > 36.64 = 2	< 36.62 = 0 36.63 – 50.42 = 1 > 50.43 = 2
7. Lateral leaf veins	< 7.79 = 0 7.80 – 7.84 = 1 > 7.85 = 2	< 7.79 = 0 7.80 – 8.10 = 1 > 8.11 = 2
8. Guard cell length (μ)	< 32.68 = 2 32.69 – 32.74 = 1 > 32.75 = 0	
8. Leaf *a/m* ratio		< 0.99 = 2 1.00 – 1.18 = 1 > 1.19 = 0

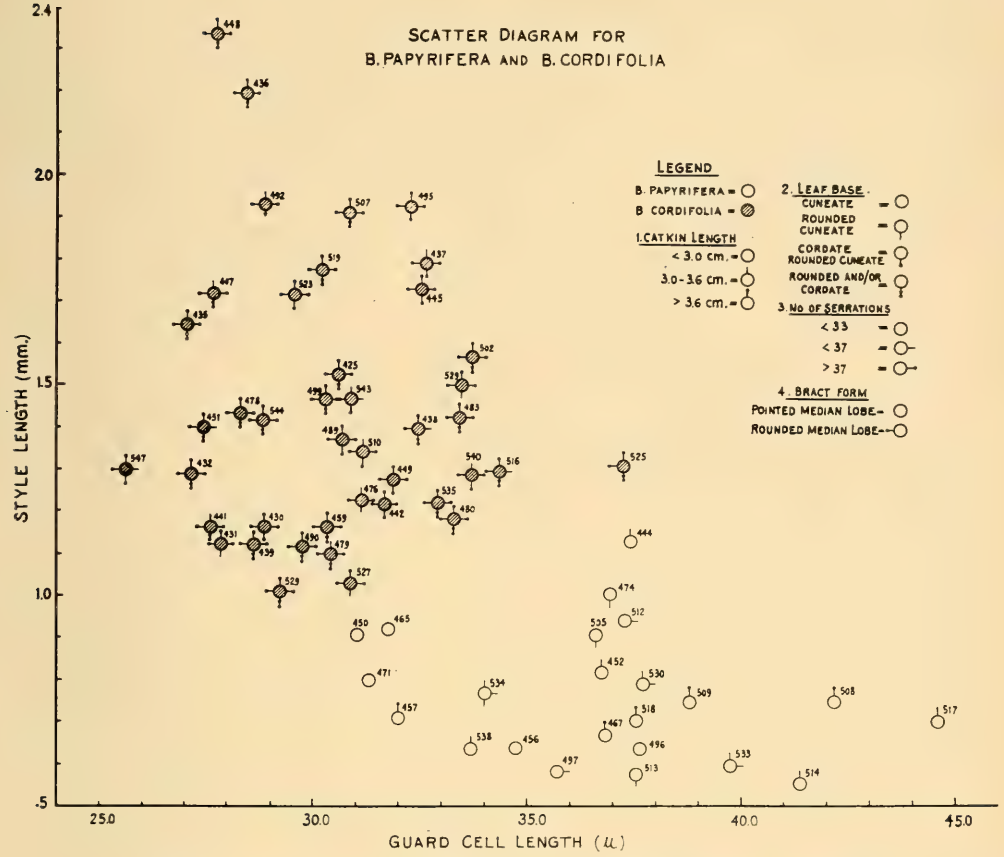

FIGURE 9. Pictorial scatter diagram of *B. papyrifera* and *B. cordifolia*.

confirms our original conclusion (Brittain and Grant, 1965b) that *B. papyrifera* var. *cordifolia* should have specific rank as *B. cordifolia* Regel, and hence, the reason for our use of the specific name for this taxon here.

Hodgdon and Pike (1964) reported that they found some trees of *B. cordifolia* (*B. papyrifera* var. *cordifolia*) on Grand Manan Island only after very diligent hunting, and Weatherby and Adams (1945) did not report this taxon at all in their list of species growing on Grand Manan. In contrast, we have found *B. cordifolia* to be in considerable abundance, and probably to be the most plentiful birch species on Grand Manan at the present time. In the uninhabited interior of the island, *B. cordifolia* was the only species present.

The late G. C. Cunningham (personal communication) said that a maritime form of *B. cordifolia* occurred along the Gulf of St. Lawrence in which the leaves were not cordate, but were broadly rounded at the base. This form was found to be abundant on Grand Manan, and exceeded the typical form. Since in all other respects, including chromosome number, it was indistinguishable from typical *B. cordifolia*, and there was a complete integration in leaf form

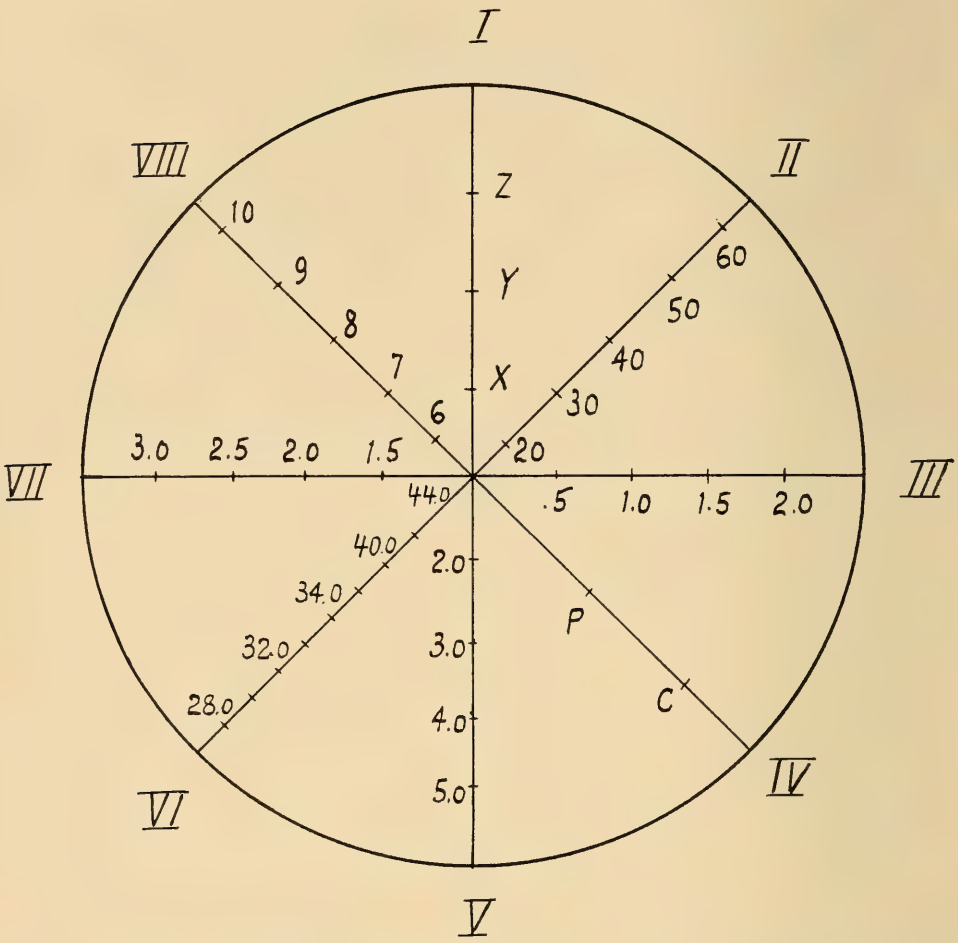

FIGURE 10. Key to the polygonal graphs of *B. papyrifera* and *B. cordifolia*. I. Chromosome number, X = 2*n* = 70 or 84; Y = 2*n* = 56; Z = 2*n* = 28. II. Number of serrations on one side of leaf. III. Style length (mm). IV. Bract form: P = median lobe tapering, lateral lobes extending porrect or recurved; C = median lobe with parallel sides and lateral lobes always porrect. V. Catkin length (cm). VI. Guard cell length (μ). VII. Achene length (mm). VIII. Number of pairs of lateral veins.

from the one to the other, we have not distinguished between the two extremes and have not tried to split off individuals into subtaxonomic categories. It may be, however, that Hodgdon and Pike (1964) mistook this maritime form for *B. papyrifera* and hence, their statement for the scarcity of *B. cordifolia*.

The Betula caerulea *complex*

In Figure 12, the hybrid index values for each specimen of *B. populifolia*, *B. caerulea* and *B. cordifolia* have been illustrated by means of a bar graph for eight measured characters. The hybrid index of a typical *B. populifolia* ranged from 0 to 5, whereas that of *B. cordifolia* ranged from 10 to 16. These two taxa

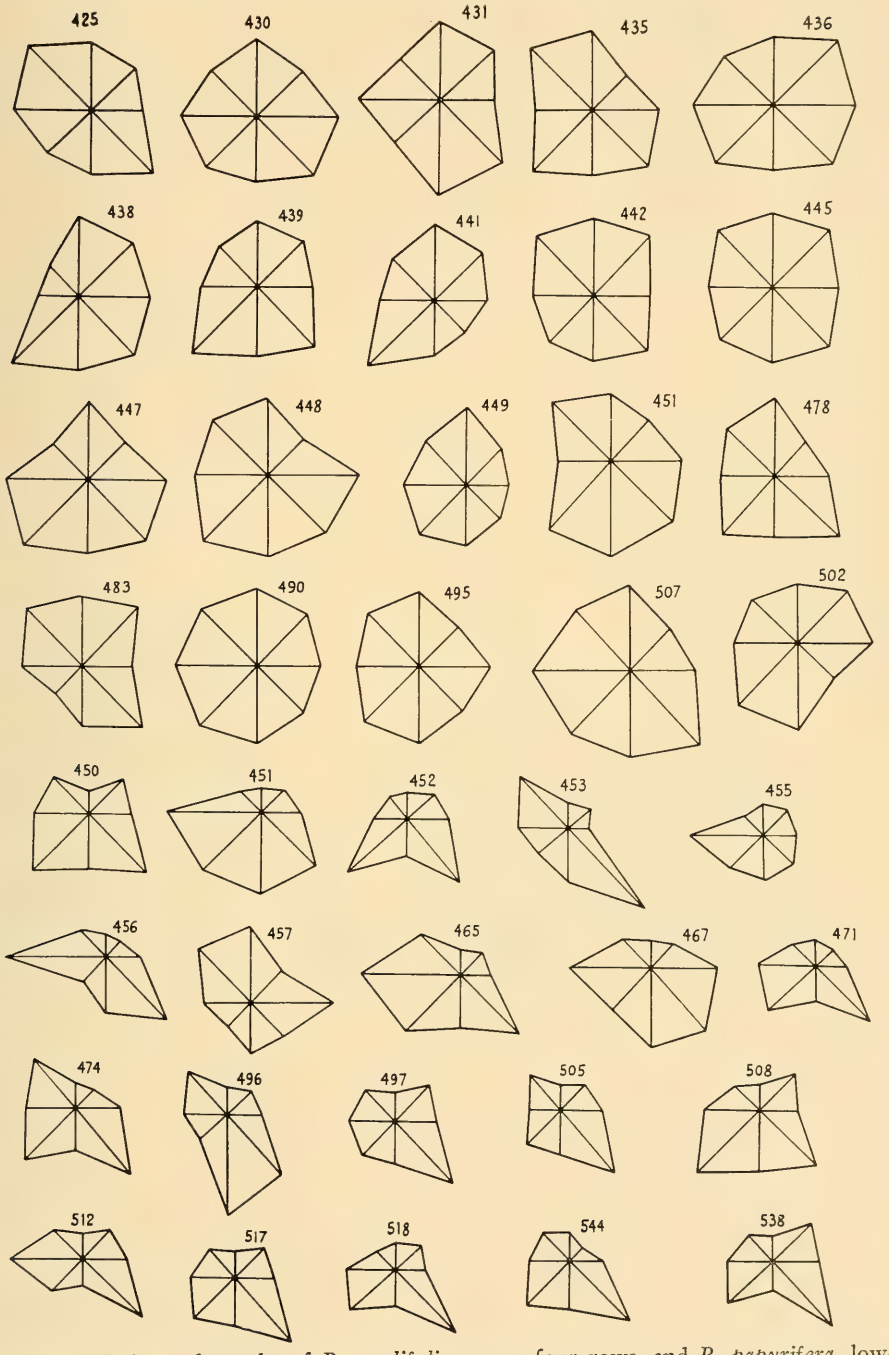

FIGURE 11. Polygonal graphs of *B. cordifolia*, upper four rows, and *B. papyrifera*, lower four rows. The polygons were selected to show the entire range of variability found for the two taxa.

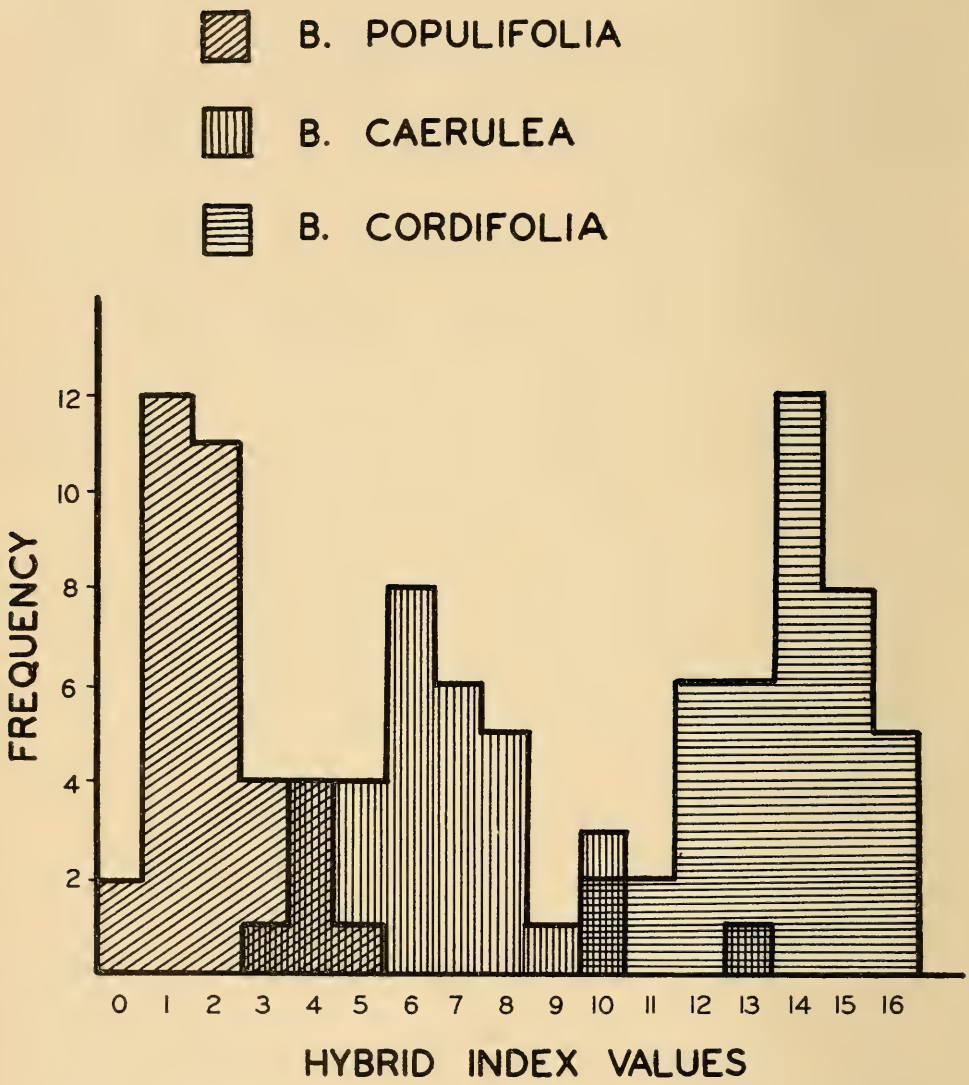

FIGURE 12. Frequency of hybrid index values of *B. populifolia*, *B. caerulea*, and *B. cordifolia*

are clearly distinct from one another by the criteria employed. In the case of *B. caerulea*, the hybrid index values ranged from 3 to 11 with one specimen having a value of 13. The values for the majority of specimens of *B. caerulea* clearly fall intermediate to those of *B. populifolia* and *B. cordifolia* with some introgression in both parental directions, that is, individuals possessing characteristics of both *B. populifolia* and *B. cordifolia*. A close comparison of our specimens of *B. caerulea* with those of *B. caerulea* and *B. caerulea-grandis* collected by Blanchard in 1903 in Vermont, revealed that all of our specimens

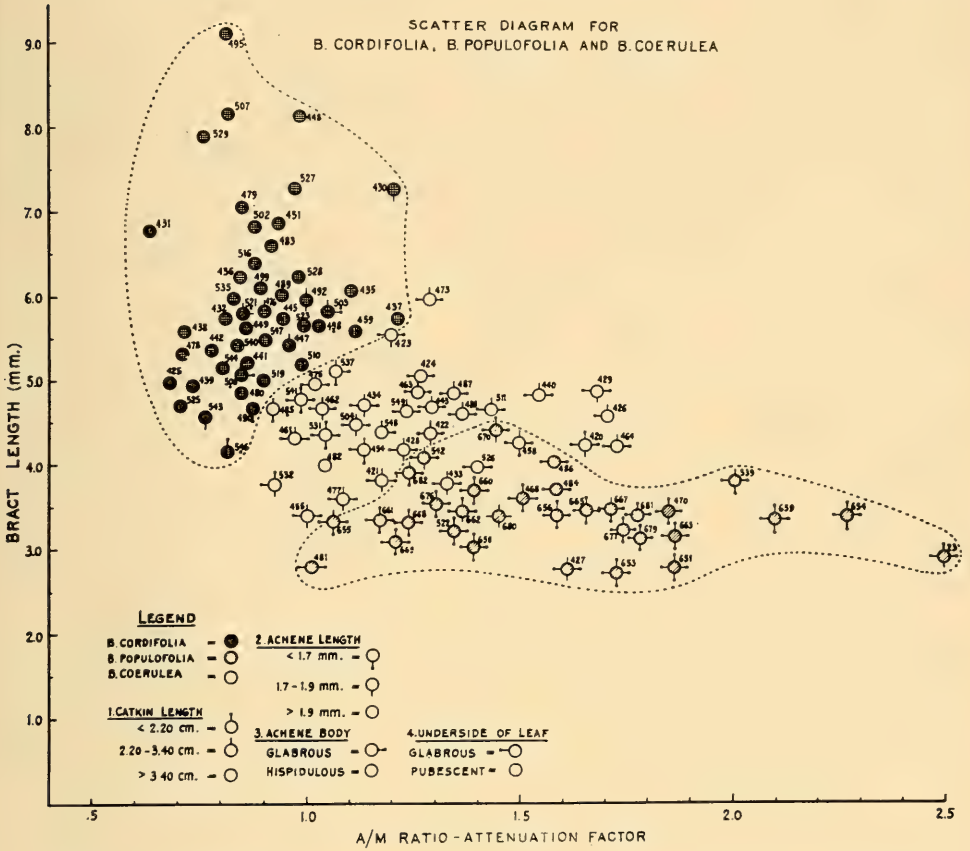

FIGURE 13. Pictorial scatter diagram of *B. populifolia*, *B. caerulea* and *B. cordifolia*.

were like Blanchard's *B. caerulea-grandis* with the exception of one specimen (No. 420) which was similar to Blanchard's *B. caerulea*. Our specimen No. 420 had a hybrid index value of 5, which was well within the variation found for our other specimens. In a *t* test comparing measurements of eight characters from a herbarium specimen of *B. caerulea* collected by Blanchard (B-6; Windham, Vermont, August 1, 1903; Brittain and Grant, 1967) with measurements of specimens of *B. caerulea* and *B. caerulea-grandis* collected on Grand Manan, all of the eight characters differed significantly between the herbarium specimen and the Grand Manan specimens. In a comparison with Blanchard's *B. caerulea-grandis* (B-18; Stratton, Windham Co., Vermont, July 17, 1903), the catkin length, achene length, leaf serrations, and guard cell measurements, were not significantly different from those specimens collected on Grand Manan, but bract length, achene width, style length, and number of lateral veins, differed significantly.

In the pictorialized scatter diagram for *B. cordifolia*, *B. caerulea* and *B. populifolia*, the leaf *a/m* ratio was used as a coordinate on one axis and the

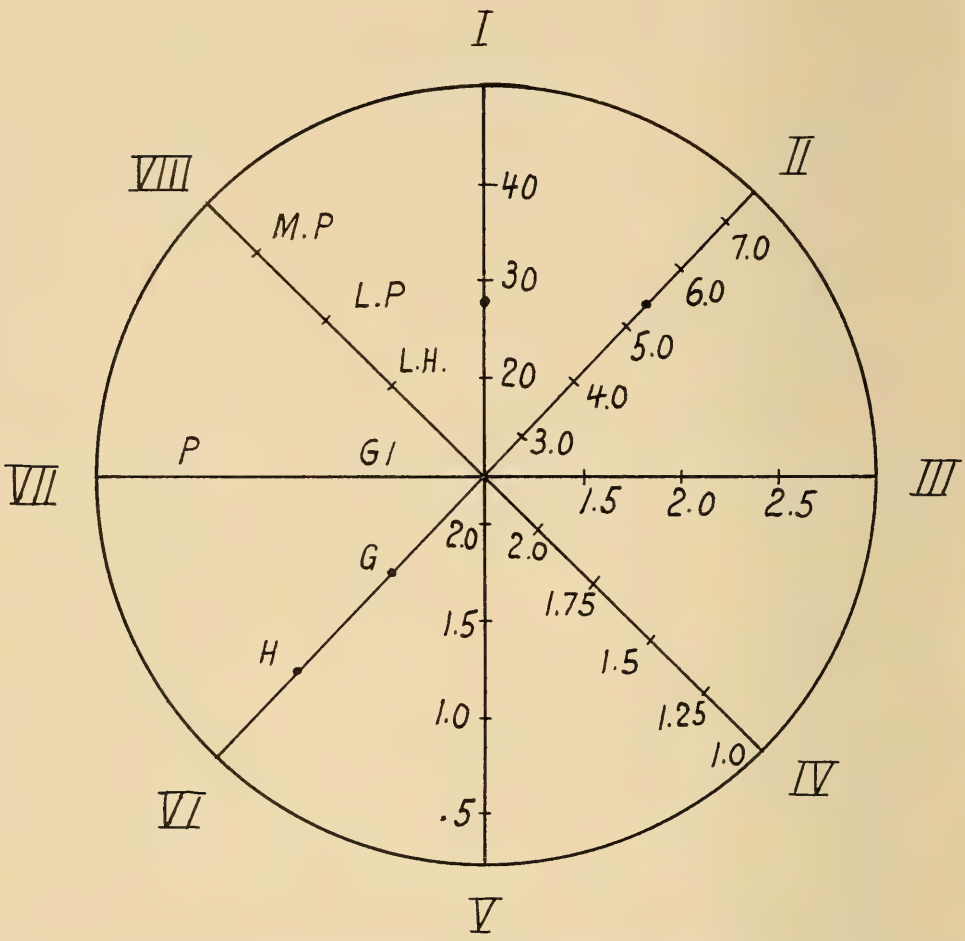

FIGURE 14. Key to the polygonal graphs of *B. populifolia*, *B. caerulea*, and *B. cordifolia* II. Catkin length (cm). II. Bract length (mm). III. Achene length (mm). IV. Achene-length-width ratio. V. Attenuation factor (a/m ratio). VI. Achene body: G = Glabrous or nearly so; H = Hispidulous. VII. Underside of leaf: G1 = Glabrous; P = Pubescent. VIII. Bract Form: L. H. = Lateral lobes horizontally extending or slightly recurved, median lobe tapering; L.P. = Lateral lobes porrect; M.P. = median lobe with subparallel sides and lateral lobes always porrect.

bract length on the other (Figure 13). Measurements for each individual were plotted. The series of dots outline individuals which belong to *B. cordifolia* and to *B. populifolia*, respectively. The individuals of *B. caerulea* numbered 433, 526 and 458 lie within the circle enclosing the *B. populifolia* specimens. Accession numbers 433 and 526 have hybrid indices of 6 and 7 which lie in the peak of the mode of the specimens represented by *B. caerulea*, however, number 458 has a hybrid index of 3 which is more characteristic of specimens of *B. populifolia*. In general, the specimens of *B. caerulea* are intermediate in position to *B. cordifolia* and *B. populifolia*, but individuals are found in the

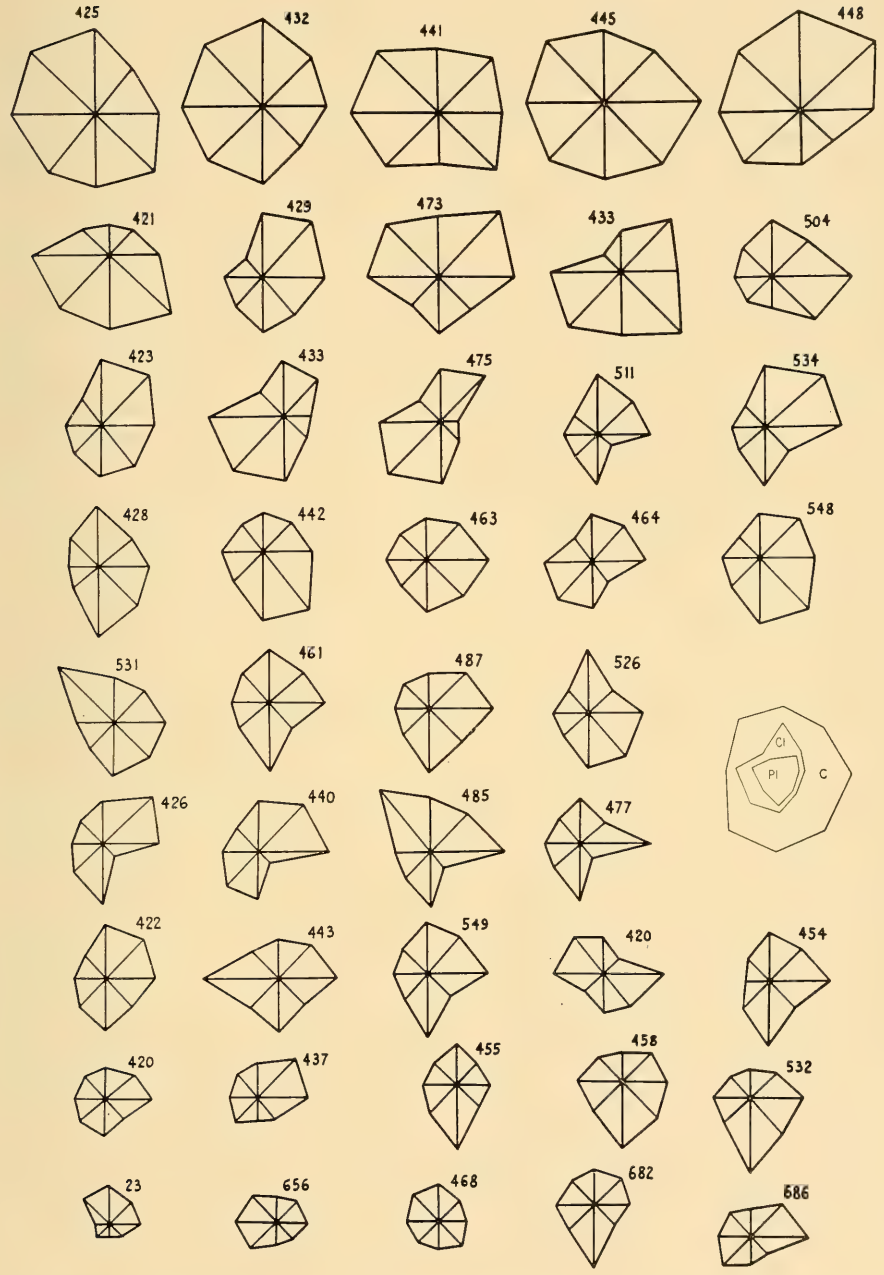

FIGURE 15. Polygonal graphs of *B. cordifolia*, first row, *B. populifolia*, bottom row, *B. caerulea*, seven center rows. The polygons were selected to show the entire range of variation within each species. Center right: Superimposed polygons illustrating mean values for these species. C = *B. cordifolia*, C1 = *B. caerulea*, P1 = *B. populifolia*.

range of both parents. Specimen number 473 with a hybrid index of 9, and numbers 423 and 475 with a hybrid index of 10, lie adjacent to *B. cordifolia* and have a high hybrid index value characteristic of *B. cordifolia.* A specimen of *B. caerulea*, number 455, plotted adjacent to those of *B. populifolia* has a hybrid index value of 3 which is in the range of specimens of *B. populifolia*, and specimen numbers 477 and 464, also lying in similar positions, have a hybrid index value of 4. Thus it may be seen that plants of *B. caerulea* overlap with values assigned to both *B. cordifolia* and *B. populifolia.*

Polygonal graphs again based on eight selected characters were prepared for each plant of *B. cordifolia*, *B. caerulea* and *B. populifolia.* The assigned values for these characters are given on the eight radii in the key to the polygons (Figure 14). Representative polygons illustrating the entire variation found for *B. cordifolia*, *B. caerulea*, and *B. populifolia* are shown in Figure 15. The polygons have been arranged to give a visual image of the morphological variation between individuals. The first row of polygons in Figure 15 are of *B. cordifolia* and the last row are of *B. populifolia.* The center seven rows are polygons of *B. caerulea.* It is readily apparent that the polygons of *B. cordifolia* and *B. populifolia* are quite distinct from one another whereas there is a complete gradation in polygon shapes from *B. cordifolia* to *B. populifolia.*

This study is the first report of *B. caerulea* and *B. caerulea-grandis* on Grand Manan Island. We consider *B. caerulea* and *B. caerulea-grandis* to share a common parentage and for the reasons presented to be different extremes of introgressants between *B. populifolia* and *B. cordifolia.* Since there is a complete range of introgressants between *B. populifolia* and *B. cordifolia* (Figure 12) we consider it meaningless to give names to different introgressants between them. Consequently, all individuals which share a common parentage between *B. populifolia* and *B. cordifolia* we are designating × *B. caerulea* Blanchard, since this was the first taxon to be described by Blanchard (1904a). It should be noted that Blanchard (1904b) himself had some doubt as to the correct nomenclature for these two individuals he described. From the hybrid index values for *B. populifolia*, *B. caerulea* and *B. cordifolia* (Figure 12) it may be clearly observed that *B. caerulea* introgresses both towards *B. populifolia* and *B. cordifolia.* From unpublished observations the degree of introgression varies in different regions and hence, in one area there may be more *B. caerulea* types (greater introgression with *B. populifolia*), or more *B. caerulea-grandis* types (greater introgression with *B. cordifolia*). Hence, our reasons for using the name *B. caerulea* for these introgressants. As we have clearly shown (Figure 12), *B. caerulea* (and *B. caerulea-grandis*) are hybrids between *B. populifolia* and *B. cordifolia*, as we earlier suspected (Brittain and Grant, 1967), and not between *B. populifolia* and *B. papyrifera* (Fernald, 1950; Brayshaw, 1966).

ACKNOWLEDGMENTS

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SUMMARY

A cytological and a morphological study employing hybrid indices, pictorialized scatter diagrams, and polygonal graphs, has been carried out on a collection of birches from Grand Manan Island, New Brunswick, namely, *B. papyrifera* Marsh., *B. papyrifera* var. *cordifolia* (Reg.) Fern., *B. populifolia* Marsh., and some hybrids *B. caerulea* Blanch. and *B. caerulea-grandis* Blanch. Somatic chromosome numbers of 28 were determined for all accessions of *B. papyrifera* var. *cordifolia*, *B. caerulea* and *B. populifolia*. Two out of seventeen seedlings of *B. papyrifera* had a somatic chromosome number of 70; fifteen had 84. Hybrid index values, pictorialized scatter diagrams and polygons showed that *B. papyrifera* and *B. papyrifera* var. *cordifolia* were clearly distinct from one another, as well as in chromosome numbers, confirming our earlier conclusion that *B. papyrifera* var. *cordifolia* should be reinstated to specific rank, namely as *B. cordifolia* Regel. This study is the first to report *B. caerulea* and *B. caerulea-grandis* on Grand Manan Island. *Betula caerulea* and *B. caerulea-grandis* are considered to share a common parentage and to represent different extremes of introgressants between *B. populifolia* and *B. cordifolia*. Since introgressants between these two taxa give a considerable number of phenotypes which individually could all be described as new taxa, we have designated the name × *B. caerulea*, to all hybrids between *B. populifolia* and *B. cordifolia*.

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ANOMALOUS CONDITIONS IN THREE SPECIES OF BIRDS

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SMITH (1942) observed a meadowlark that had lost all its toes and part of its tarsi, while Ernst (1943) noted a Pied-billed Grebe with a deformed wing. Threlfall (1963) recovered an oystercatcher that had lost the whole of its left foot and toes 2 and 4 of its right foot. Harris (1964) recorded that at the end of the breeding season in a Herring Gull colony, on Skomer Island, West Wales, chicks were often seen with broken and amputated wings. In none of these cases was the underlying bony structure of the mutilated or injured limbs examined. Tiemeier (1941) found evidence of repaired bone injury in some birds, while Abbott (1943) recorded two cases of bone repair in ducks.

During a survey of the helminth parasite burden of marine birds in Newfoundland four birds were collected in which anomalous conditions were noted.

On 8 May 1968, a Leach's Petrel (*Oceanodroma leucorhoa*) with a deform-

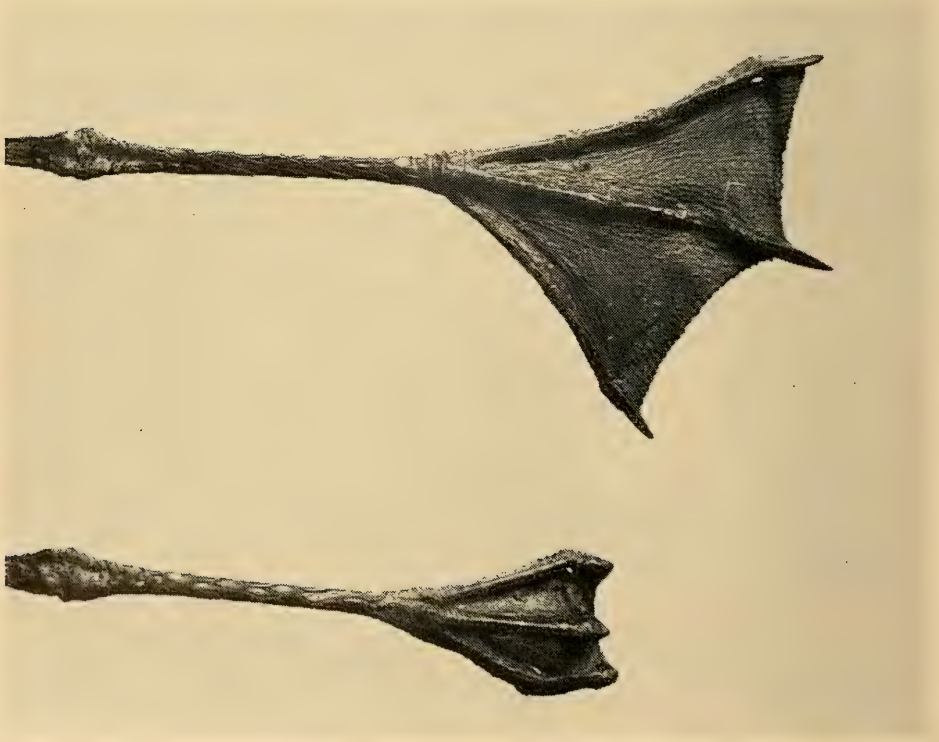

FIGURE 1. Showing the feet of the Leach's petrel.

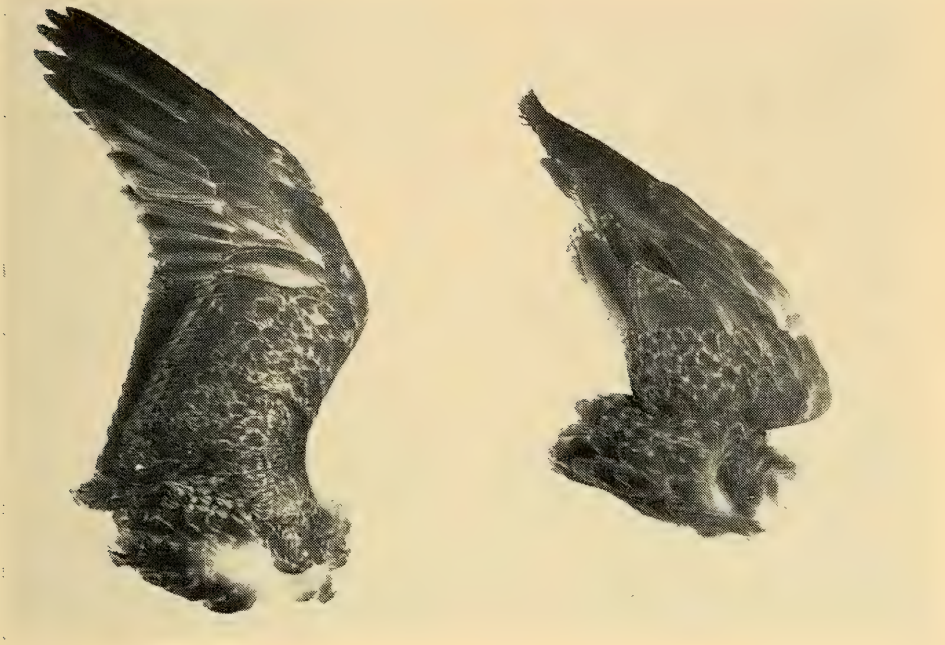

FIGURE 2. Showing the deformed wing and a normal wing.

ed foot was found on Gull Island, Witless Bay, Newfoundland. A superficial examination of the foot (Figure 1) would lead one to believe that the deformity was the result of an error in the developmental processes of the bird, as the toes seemed to bear rudimentary claws. When the undersurface of the foot was examined an extra triangular piece of skin was found extending from the first joint of the second toe to the tip of the fourth toe, forming a small sac of skin with the normal web.

The skin was then removed so that the underlying bony structures might be examined. It was found that the foot had in fact been severed at some time during the animal's life. The second toe having been removed at the second joint, while the third toe had been severed 1.5 mm. beyond the first joint. The wound left when the foot was removed had healed completely, the bird being completely normal in every other respect. The extra piece of skin under the foot could be explained if a flap was left hanging when the foot was removed, the torn tissues healing in the position described. The claw-like structures were found to be modified scales. Herring Gulls and Great Black-backed Gulls destroy many hundreds of petrels every year (Threlfall, 1968) on the island where the specimen was found and it could well be that the original injury was caused by one of these creatures.

A bridled Common Murre (*Uria aalge*) was recovered on 16 July 1968 from a gill net in which it had become entangled and drowned, several hundred feet off-shore from Gull Island. The bird was an adult female and apparently

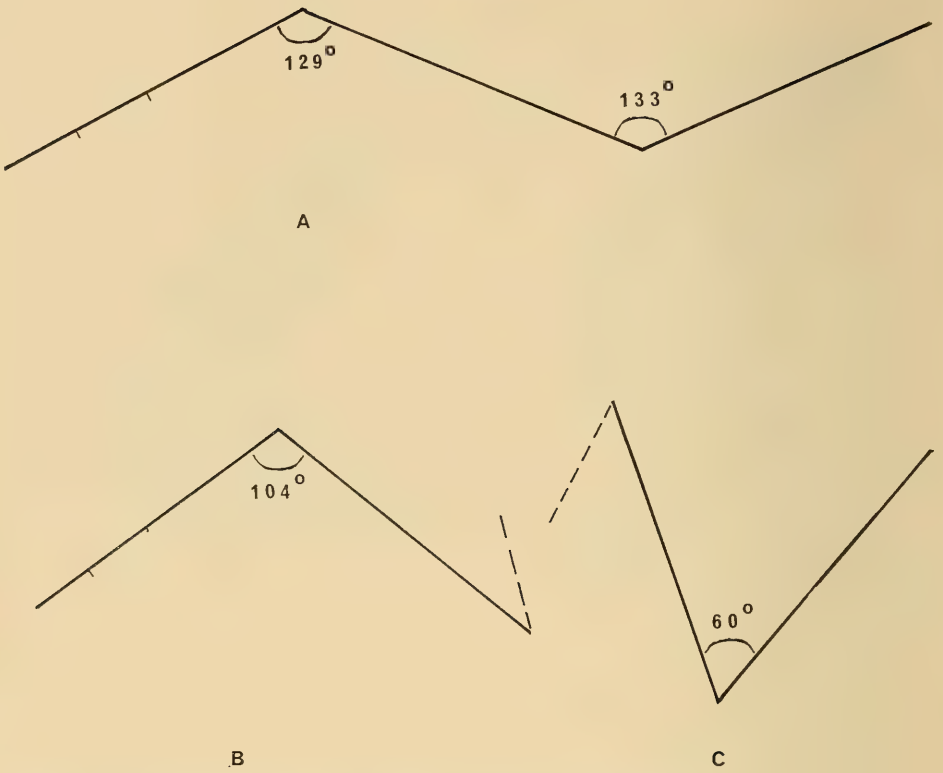

FIGURE 3. Showing the degree to which the wings could be opened.
A: normal wing.
B: distal end of deformed wing.
C: proximal end of deformed wing.
(Two figures were necessary in the case of the deformed wing due to the bones opening in 2 planes and not 1 as in a normal wing.)

healthy. It was found that the left leg had been amputated approximately 1.5 cm. below the tibio-tarsal/tarso metatarsal joint. The stump of the leg had healed completely and when the skin was removed a layer of fibrous connective tissue, approximately one eighth of an inch thick, was found covering the end of the bone. As murres use their wings for underwater propulsion and the feet for steering it is unlikely that this injury would have any great effect on the life of the creature.

On 7 June 1967, an adult, female Herring Gull (*Larus argentatus*) was found dead on Great Island, near Bauline, Newfoundland. Autopsy revealed the presence of blood in the lungs, but no other pathological symptoms were seen. A large herring (*Clupea harengus*) was the only food found in the creature's digestive tract. The joints of the animal's left foot were found to be greatly swollen, and when the skin was removed from the toes large deposits of connective tissue were found around all the joints. The condition may have been arthritic in nature.

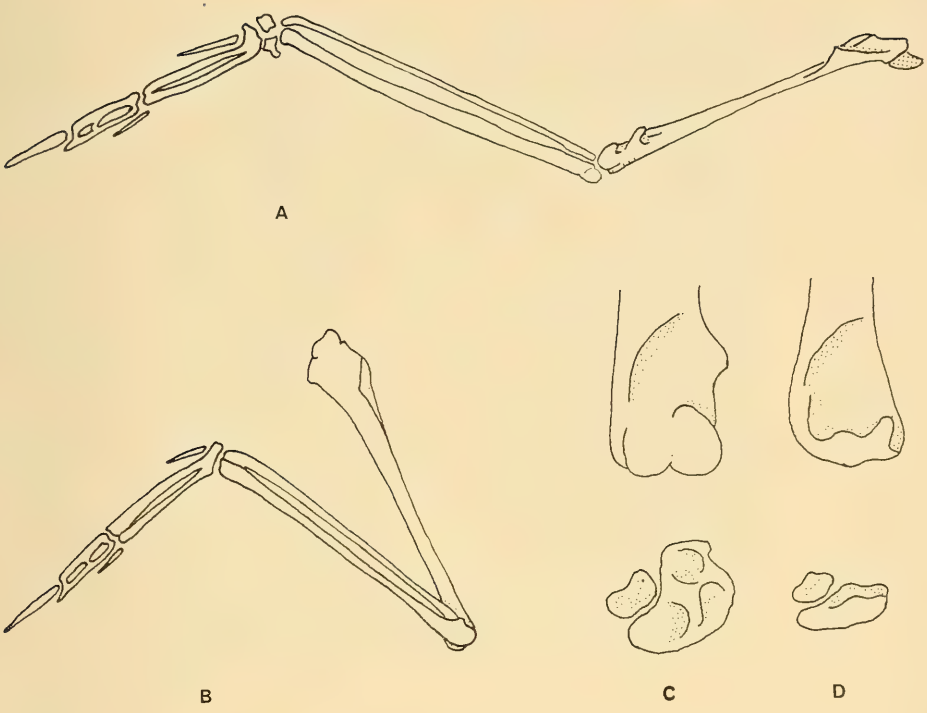

FIGURE 4. A: bones of a normal wing.
B: bones in the deformed wing.
C: articular surfaced of the humerus, radius and ulna in a normal wing.
D: as above, but in deformed wing.

During a field trip to Gull Island 4 August 1967, a Herring Gull chick which was unable to fly was collected. The chick was unable to open its left wing to its fullest extent due to a deformation of the bone structure (Figures 2, 3, and 4). Examination of the bones revealed that there was complete ankylosis of the metacarpal bone with the pisoulnare and scapholunare, a certain amount of movement being possible between the end of this fused bone and the distal end of the radius and ulna. The second phalanx in the deformed wing was approximately half the length of the same phalanx in a normal wing. The articulatory surfaces of the proximal end of the radius and ulna, and the distal end of the humerus, were very much reduced (Figures 4C and D). The bones in the deformed wing did not lie in one plane as is seen in a normal wing, but lay in two planes (approximately 75° between the planes) (Figure 3). The proximal end of the humerus did not articulate with the glenoid cavity in the normal way the head of the bone having been twisted through 90°, relative to the position of a normal bone (Figures 4A & B). The distal end of the humerus seemed to have been twisted through approximately 60° relative to the longitudinal axis and the distal end of a normal bone.

No sign of injury was seen in the bone and it would appear that the condition was present at the time of hatching.

This work was supported by the National Research Council of Canada (grant NRC-A3500) to whom I express my gratitude.

Biological studies from Memorial University of Newfoundland No. 123.

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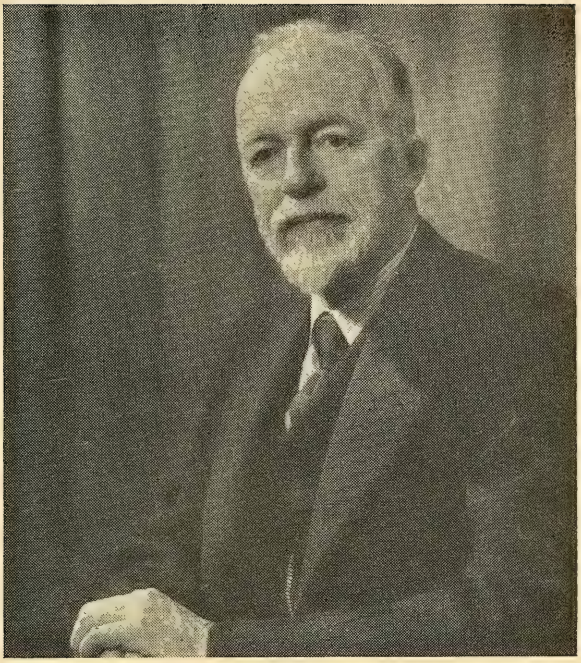

PROFESSOR EDMUND M. WALKER

1877-1969

F. P. Ide

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With the passing of Dr. Walker in February, 1969, a contact with Natural History events over a period of almost unique extent has been broken. Although his main scientific contributions were in Entomology the breadth of his interests encompassed many other branches of the sciences and other cultural fields.

He was born in Windsor, Ontario in October, 1877, the eldest son of Byron Edmund Walker, later Sir Edmund, who was sometime head of the Canadian Bank of Commerce. He spent much of his early life in Toronto and received most of his formal education there. After attending Harbord Collegiate he entered Arts and Medicine at the University receiving the BA degree in 1900 and MB and Medical Council in 1903. This was followed by a year as an intern at the Toronto General Hospital. However, his early interest in and

dedication to Natural Science destined him for a career in teaching and research and he did not practise Medicine. The opportunity came with his appointment as an Assistant under Professor Ramsay Wright for the 1904-05 session. He then went abroad for a year of Post Graduate training at the University of Berlin taking Invertebrate Zoology with Professor Paul Deegener and General Zoology with Professor F. E. Schulze. On his return in 1906 he was appointed a Lecturer at Toronto, became Professor of Invertebrate Zoology in 1926 and was Head of the Department of Biology, (Zoology after 1940), 1934-1948. On retirement he was appointed Professor Emeritus and remained active in research as Honorary Curator of Invertebrates at the Royal Ontario Museum of Zoology until ill health incapacitated him early in 1965.

In addition to his original courses in Invertebrate Zoology he introduced a course in Forest Entomology following the creation of the Faculty of Forestry in 1907 and gave a course to medical students in Parasitology and later developed an advanced course on the Phylogeny of the Arthropods to which his own research contributed significantly. It was during his incumbency of the Headship that Animal Physiology and Human Genetics were introduced into the curriculum.

He was married twice, first to Eleanora Walzel of Halbstadt, Cchecho-slovakia by whom there were three daughters and a son and second, to Dr. Norma H. Ford, a former student and member of the staff who developed Human Genetics in the University and headed the genetics unit in the Toronto Hospital for Sick Children. After relinquishing much of his course work on becoming Head of the Department he resumed teaching of some of it during part of World War Two, thus adding considerably to the already heavy demands of the Headship.

His own research resulted in more than 130 scientific papers over the years 1897-1966, a complete list of which is given by Dr. Glenn Wiggins[1]. Many of these were taxonomic papers on the Orthoptera and Odonata. Outstanding classics in his field were a monograph on the dragonfly genus *Aeshna* and one on *Somatochlora* in which his skill as an illustrator is probably best shown; a series on the anatomy of the relict orthopteroid insect *Grylloblatta campodieformis* found in 1913 on Sulphur Mountain at Banff and his three-volume work – The Dragonflies of Canada and Alaska – the last volume of which was nearly completed before illness brought these activities to an end.

The excellence of his research brought recognition in election to office and fellowship in scientific societies in which he was active. These included Fellow of the Royal Society of Canada and President of Section V in 1936 and recipient of the coveted Flavelle medal in 1960; Fellow of the Entomological Society of America, Vice-President in 1917 and President in 1939; Fellow of the Entomological Society of Ontario, 1963, of which he was President 1910-12, one of the first Honorary members and Editor of the Canadian Entomologist 1910-20; Fellow of the Royal Entomological Society of London. He was an Honorary member of the Entomological Society of Canada from its founding in 1958 and a

[1]Wiggins, Glenn. 1966. Centennial of Entomology in Canada, 1863-1963—A tribute to Edmund M. Walker. Univ. of Toronto Press, Contr. 69, Life Sciences, Royal Ontario Museum, 94 pages.

fellow; an Honorary member of the Canadian Society of Zoologists from its founding in 1962; a member of the Toronto Field Naturalists' Club from its founding 1920, President in 1926 and later became a Director and President of the Federation of Ontario Naturalists. He was Honorary Editor of the Transactions of the Royal Canadian Institute 1924-45, and an Honorary member. Further recognition of his outstanding contribution came when he was made a Vice-President of the 10th International Congress of Entomology, Montreal, 1956 and named Entomologist of the Congress. At the Celebration of the Centennal of the Entomological Society of Ontario in 1963 he was one of the recipients of the D.Sc. honoris causa, from Carleton University.

The late Professor Walker's interest in Natural History was aroused early in childhood and was maintained throughout a long life. He was fortunate in being placed in an environment which allowed him to follow his early inclination and to receive along the way encouraging stimulus from some of the early workers in his field.

A sensitive and rather shy man, he was very human, with a fine sense of humour not always revealed in his daily contacts but enriching the relation with his students, fellow workers and others enjoying the privilege of his closer acquaintance. He excelled as a keen, critical observer and never ceased to be aroused and excited by what he saw. This enthusiasm was infectious and rendered him a stimulating teacher and entertaining guide. His wide knowledge of the trees of the forest, shrubs and plants and the associated animals made a trip in the field an enriching experience for kindred spirits and some of his most stimulating instruction was given in this setting. This is where questions and challenging problems presented themselves which required investigation in the laboratory by closer scrutiny under the microscope. An obscure point in a life cycle was clarified by rearing the animal in the laboratory. By painstaking anatomical study our knowledge of insect form and function was increased and relationships demonstrated. Ever in mind, also, was the relation of animals to their environment as revealed by studies of their habitats.

He was quick, also, to appreciate the significance of findings of newer branches of zoology for his field but realizing his limitations, refrained from extending his own activities at the expense of thoroughness in his chosen sphere.

His work so absorbed him that it was at the same time his chief recreation particularly that part which took him into the field. But he had many other intellectual interests including literature, music and art from which he derived much pleasure. He was an artist of considerable accomplishment, painting the scenery he so keenly appreciated, and finding satisfying relaxation in this diversion.

At a dinner in Hart House, 1948, on the occasion of his retirement as Head of the Department of Zoology, he said "I believe that the future for biology is a bright one and that there is more room than ever before for students of different temperaments and different outlooks on life".

NOTES

Distribution Extensions of Manitoba Plant Species

The main reference to the distribution of plant species in Manitoba is Scoggan's Flora of Manitoba (1957). Since this flora was published, many more plant collections have been made, and I have found range extensions for many species in collections made since 1964.

One collection in particular is noteworthy. This is a collection made west of Child Lake in the Duck Mountain Forest Reserve, at approximately 51° 33′N, 101° 15′W. No less than nine grass species were collected which are typical of the Festuco-Danthonietum spicatae Looman, 1969 – the *Festuca scabrella* association (Moss and Campbell, 1947; Blood, 1966)–and are northward extensions of their known range in Manitoba. Undoubtedly, more intensive collecting will bring many more range extensions to light.

In the following enumeration the "Known range" is that given by Scoggan, unless otherwise indicated. The position of the locations given was determined on maps of the National Topographic Series, Scale 1 : 250.000. Voucher specimens of all collections are in the herbarium of the Research Station, Swift Current, Saskatchewan (SCS), and some duplicates are in the herbarium of the Plant Research Institute, Canada Department of Agriculture, Ottawa (DAO).

Taxus canadensis Marsh

Hecla Island, 51° 11′N, 96° 38′W, Looman 9010; Pine Dock, 51° 37′N, 96° 50′W, Looman 9040; Bull Head Bay, 51° 40′N, 96° 53′W, Looman, 9063. In Muskeg. Known range: "Apparently limited to the forested area southeast of Lake Winnipeg . . . near the Ontario boundary. . ." A report from York Factory is considered doubtful. Boivin (1967) knows of only one location, at Indian Bay, besides the York Factory one. The identity of my specimens is confirmed by Dr. Boivin.

Festuca scabrella Torr. (*F. altaica* Trin. var. *major* (Vasey) Gl.)

W. of Child Lake, Duck Mountain, Looman 11899. In fescue prairie. Known range: northernmost collection Riding Mountain.

Helictotrichon hookeri (Scribn.) Henr.

W. of Child Lake, Duck Mountain, Looman 11896. In fescue prairie. Known range: northernmost collection Riding Mountain.

Danthonia intermedia Vasey.

W. of Child Lake, Duck Mountain, Looman 11905. In fescue prairie. Known range: Riding Mountain (Blood, 1966).

This species has been reported from Manitoba by Macoun (1888) who lists it ". . . from Portage la Prairie westward to the source of the Qu'Appelle; . . ." Further, "Prairies at Emerson, Manitoba (*Burgess*) Red River, Manitoba 1827. (*Douglas*)."Dr. Boivin, confirming my identification, writes that these reports have been discounted by later authors, and that specimens from Manitoba under the name *D. intermedia* have been revised to *D. spicata*. Scoggan excludes *D. intermedia* from the flora of Manitoba and cites *D. spicata* as the source of earlier reports of the former. I excluded the species from the Festuco-Danthonietum spicatae (Looman, 1969) because I never found the species. But Blood (1966) lists it as occurring in fescue prairie in the Riding Mountain. An intensive search in both the Duck Mountain and Riding Mountain areas confirmed its occurrence in Manitoba.

Stipa spartea Trin.

W. of Child Lake, Duck Mountain, Looman 11901. In fescue prairie. Known range: south edge of Duck Mountain.

Stipa spartea Trin. var. *curtiseta* Hitchc.

W. of Child Lake, Duck Mountain, Looman 11900. In fescue prairie. Known range: as far north as Riding Mountain.

Stipa richardsoni Link

W. of Child Lake, Duck Mountain, Looman 11902. In fescue prairie. Known range: "Known in Manitoba only from Riding Mountain".

Muhlenbergia racemosa (Michx.) BSP.

W. of Child Lake, Duck Mountain, Looman 11897. In fescue prairie. Known range: northernmost collection Dauphin.

Muhlenbergia richardsonis (Trin.) Rydb.

W. of Child Lake, Duck Mountain, Looman 11906. In fescue prairie. Known range: northernmost collection Birds Hill near Winnipeg.

Calamovilfa longifolia (Hook.) Scribn.

W. of Child Lake, Duck Mountain, Looman 11903. On steep grassy slope. Known range: northernmost collection Dropmore.

Andropogon scoparius Michx.

W. of Child Lake, Duck Mountain, Looman 11908. On steep grassy slope. Known range: northernmost collection Dropmore.

Vitis riparia Michx.

Lake Audy, Riding Mountain, 50° 46′N, 100° 14′W, Looman 11919. In shrubbery along lake. Known range: northernmost collection Victoria Beach, about 55 mi. northeast of Winnipeg.

Arctostaphylos rubra (Rehd. & Wils.) Fern.

South of The Pas, at about 53° 27′N, 101° 22′W, Looman 10353, in muskeg. Known range: southernmost collection Hill Lake, north of Lake Winnipeg.

Scutellaria leonardi Epl.

West of Rennie, 49° 52′N, 95° 34′W, Looman 8830. On mosses over rock outcrop. Known range: The species is known from North Dakota (Stevens, 1950), and its range as given by Gleason (1952) excludes Canada. My identification of this species is confirmed by Dr. Boivin, who calls it ". . . a somewhat unexpected addition to the flora of Canada". *S. leonardi* Epl. was formerly included in *S. parvula* Michx., which occurs in Quebec and Ontario. It differs from the latter by not being glandular-hairy on either stem or leaves and by having entire lanceolate-deltoid, rather than dentate, ovate leaves.

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Accepted May 2, 1969

An Adult White-winged Black Tern in New Brunswick

ON July 27, 1968, we were watching birds at Grand Point (45°55′N, 66°05′W) near Douglas Harbour, Queen's County, N.B. This promotory is on the northern shore of Grand Lake, the province's largest body of fresh water, and from it a shingle bar juts out into the lake. At the water's edge near the end of the bar were several Great Black-backed Gulls *Larus marinus*, Herring Gulls *L. argentatus*, Ring-billed Gulls *L. delawarensis*, and Bonaparte's Gulls *L. philadelphia*. There were also about 20 Common Terns *Sterna hirundo*. Nearby and at a slightly higher elevation there was a discrete flock of about 100 resting Black Terns *Chlidonias niger*. The birds were disturbed by our close approach and circled for a while before settling a short distance away. It was after we had put them to flight a second time that we noticed one of the supposed Black Terns was different from the others. With the aid of binoculars and telescope and in bright sunny weather we observed this bird during the next two hours.

We noted the following plumage details during observation of the bird on the ground and in flight.

Upper parts: forehead and front of crown white; rear of crown and nape black; back and scapulars gray; rump and upper tail coverts white.

Side of head: lores and side of face white; ear coverts black, joined with the black of the crown and indistinctly with that of the breast.

Under parts: chin and throat white; breast blotched black and white; belly, axillaries and flanks black; under tail coverts white.

Wings: remiges dark gray as in *Ch. niger*; major coverts gray, paler than remiges; lesser and probably median coverts white; marginal coverts pale gray; wing linings black, very slightly blotchy due to onset of molt.

Tail: retrices almost wholly white but with some pale gray streakings on the tips dorsally.

Soft parts: bill and legs appeared black.

We identified the bird as a molting White-winged Black Tern *Chlidonias leucopterus*. Color photographs were taken and a field sketch made. These have been submitted for comment to W. Earl Godfrey at the National Museum of Natural Sciences.

Due to the presence of unmolted wing coverts, the bird, while on the ground, appeared much paler than any of the Black Terns with which it associated. This distinction could be expected to disappear as the molt progressed. Black Terns were present in all stages of molt and none was seen which appproached this degree of paleness. In flight, the white rump and predominantly white tail were the most noticeable distinguishing features and, when the bird was high enough, the black wing linings also. Due to the onset of molt, the white upper wing coverts were not a good field mark. In fact the dark "saddle" formed by the contrast of pale wings and dark back, often given as a characteristic of sub-adult and winter-plumage *Ch. leucopterus*, is unreliable at a time when molting juvenal *Ch. niger* can show a "saddle" of brown juvenal back feathers and gray wings.

The following day we returned to the area with N. Moore and W. Wilson. We soon located the bird among the resting Black Terns and approached to about 40 yards, without learning anything new. On July 29 it was seen again by S. Lunn and P.A.P. On that occasion the bird dissociated itself from the Black Terns and flew southwest down the lake until it disappeared from view. Later in the day, however, C. Archibald, D. Christie, and M. Majka successfully located it at the usual place. The bird was last seen by N. Moore 24 hours later. It was not, to our knowledge, independently identified. J.H.M. has seen White-winged

Black Terns elsewhere, in the United Kingdom and in Libya. The other observers could claim no previous experience with this species.

By August 1 about half the Black Terns had left the area and Common Terns were more numerous. The Black Terns were probably from the breeding colony at Big Timber Lake, seven miles west of Grand Point, which Peters (1941) reported. Recent spring observations of up to 50 birds at nearby McGowan's Corner suggest that the colony has expanded considerably. The White-winged Black Tern has not before been reported from Canada (Godfrey, 1966), but there is a nearctic specimen and several sight records of this Old World species that are worth citing. A breeding female was shot near Black Hawk Island, Lake Koshkonong, Wis. on July 5, 1873 (Kumlien and Hollister, 1903). Two, one an adult in full breeding plumage, were reported at Scituate, Mass. on May 25-27, 1954 (Griscom and Snyder, 1955). The species was noted at Nauset and Monomy, Mass. on July 18 and August 4, 1960 (Hill, 1965). Bagg (1963) cited the occurrence of one at Salisbury, Mass. July 11-18, 1963. Scott and Cutler (1963a, 1963b, 1964a, 1964b, 1965) reported the repeated observation of one at Chincoteague Refuge, Va. Most of the authors referred to the association of the White-winged species with Black Terns. Peterson, Mountfort, and Hollom (1966) state that the two species are frequently found together throughout the year.

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Accepted August 15, 1969

Bewick Wren, Host to Brown-headed Cowbird

In 1967, the Ornithology Section of the Victoria Natural History Society, commenced a limited study on the hosts of the Brown-headed Cowbird (*Molothrus ater* (Boddaert.)) in the Victoria area.

Through the kind co-operation of Dr. G. C. Carl, Director of the British Columbia Provincial Museum, who acted as the "clearing house" for phone calls, we received many reports on nests containing cowbird eggs and young cowbirds being fed.

There were the usual reports of Chipping Sparrows, White-crowned Sparrows, Song Sparrows, Oregon Juncos, American Goldfinch and Yellow

Warblers either incubating or feeding young cowbirds.

There were, however, some extremely interesting reports on unusual hosts. On August 13, 1968, T. Davies observed a cowbird being fed by a Wilson Warbler. In Bulletin No. 233, Smithsonian Institute, 1963, it states that only sixteen instances of cowbird parasitism were reported for this warbler. There were two reports of Western Flycatchers acting as the host.

On August 1, 1967, there was an observation, by Miss M. C. Melburn, of the feeding of a cowbird by a female Golden-crowned Kinglet. I have not been able to find another reference to this species acting as a host.

The writer was phoned, on June 12, 1967, to inspect a nest which had been made in a peg bag, which was hanging under the porch of a house in Oak Bay, one of the municipalities of Greater Victoria. The report said that there were "four small, creamy white eggs, and one larger egg which was bluish covered with brown blotches." With Mr. M. C. M. Matheson I inspected the nest and found that a Bewick wren was the host.

Up to 1963 there had been one report as listed in Bulletin No. 233. I communicated with Dr. D. B. Peakall, Department of Zoology, Cornell University, Ithaca. He replied stating, "we have checked the nest record cards that we have on hand for this species over the last four years and find that we do have one other record of a cowbird egg in a Bewick wren nest and one being hatched. It is from a Mr. D. Patterson, 1966, in Tennessee."

I also wrote to the Department of Zoology, University of British Columbia, Vancouver, to enquire if they had any records in their nest record cards. I learned that the nest observed and photographed by Mr. Matheson and myself was the first record for British Columbia.

The wren raised the cowbird but owing to its size and weight the other two wren chicks succumbed. Two eggs did not hatch.

In the Old World cuckoos, the eggs closely resemble their hosts but in the Brown-headed Cowbird this adaptive resemblance does not appear to have taken place. However, that such similarity is not essential is amply shown by the great number of young cowbirds observed in the Victoria area each year.

The Brown-headed Cowbird is believed to have entered North America through Mexico, spreading its range both easterly and westerly as the forests were cut and turned into grasslands. The first record for British Columbia was in 1939 when Dr. I. McT. Cowan saw ten cowbirds at Tupper Creek. It was not until 1955 that the birds appeared in the Victoria area.

The cowbird truly lives up to it's scientific name "Molothrus" meaning vagabond, tramp or parasite. Its common name, cowbird, formerly buffalobird, is self-explanatory.

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Long-billed Dowitchers in New Brunswick

ON October 11, 1968, Pearce was surprised to see a flock of five dowitchers in a brackish marsh at Castalia, Grand Manan, N.B. where he had not previously seen dowitchers as late in the fall. Three of the birds bulked a little larger than the others and two were exceptionally long billed. No plumage differences were discerned. Three birds from the group were collected. The skins were prepared by Brown. We are

grateful to W. Earl Godfrey for confirming our tentative identifications. Data are as follows, specimen numbers referring to the collection of Brown and measurements being in mm:

No. 730. *Limnodromus scolopaceus* (Say). Sex ♀; wing, 155; tail, 66; exposed culmen, 76; tarsus, 45.

No. 731. *L. scolopaceus*. Sex ♀; wing, 152; tail, 60; exposed culmen, 60; tarsus, 41. (This specimen has been donated to The New Brunswick Museum.)

No. 732. *L. griseus griseus* (Gmelin). Sex ♀; wing, 138; tail, 59; exposed culmen, 52; tarsus, 35.

Boardman (1903) reported the Long-billed Dowitcher as the Greater Long-beak *Macrorhamphus scolopaceus* (Say) and stated it was rare at St. Andrews, but no specimen evidence referable to New Brunswick was noted by Squires (1952). Pitelka (1950) cited one taken at Sable Island, Nova Scotia, on October 31, 1897. The present record establishes the known occurrence of the species on the Atlantic coast approximately 50 miles farther north.

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Arrival Dates of Birds at Churchill, Manitoba, 1968

A NUMBER of ornithological studies have been conducted in recent years in the Churchill, Manitoba area, but most were initiated in June and little information has been published on the spring arrival dates of most species.

During late spring and summer of 1968, arrival dates were recorded for most species with the exception of some that had arrived before May 18 including the Horned Lark (*Eremophila alpestris*), Lapland Longspur (*Calcarius lapponicus*), and Snow Bunting (*Plectrophenax nivalis*). From May 18 through June 9, bird observations were made daily while conducting research on Canada Geese (*Branta canadensis*) for the Manitoba Wildlife Branch, Department of Mines and Natural Resources.

On May 18, the ground was approximately 85% snow covered with little open water. The high was 28 F with northerly winds 20-28 mph. Similar weather conditions occurred May 19, 20, 21, and 23. On May 24, surface winds changed to the southwest and the temperature reached 66 F. Southwest winds continued through May 25 and 26, with temperatures reaching 73 F and 72 F, respectively. The three-day warming trend opened many ponds and smaller lakes and brought in large numbers of migrating birds. Thawing was again delayed when cold air arrived at 2:00 a.m., CST, May 27, and remained through June 3.

The following list represents 1968 first arrival dates for species at Churchill, Manitoba.

Acknowledgments

The authors wish to thank Clait E. Braun and Dr. Ronald A. Ryder for help in preparation of the manuscript.

SPECIES	DATE
Arctic Loon *Gavia arctica*	May 27

Red-throated Loon	
Gavia stellata	June 9
Horned Grebe	
Podiceps auritus	May 22
American Bittern	
Botaurus lentiginosus	June 4
Whistling Swan	
Olor columbianus	May 24
Canada Goose	
Branta canadensis	April 22[1]
Brant	
Branta bernicla	June 13[2]
White-fronted Goose	
Anser albifrons	May 23
Snow/Blue Goose	
Chen hyperborea	May 20
Mallard	
Anas platyrhynchos	May 24
Black Duck	
Anas rubripes	May 27
Pintail	
Anas acuta	May 14[3]
Green-winged Teal	
Anas carolinensis	May 24
American Widgeon	
Mareca americana	May 24
Shoveler	
Spatula clypeata	May 22
Greater Scaup	
Aythya marila	May 26
Lesser Scaup	
Aythya affinis	May 23
Oldsquaw	
Clangula hyemalis	May 23
Common Eider	
Somateria mollissima	June 5
White-winged Scoter	
Melanitta deglandi	May 30
Surf Scoter	
Melanitta perspicillata	May 24
Common Scoter	
Oidemia nigra	June 5
Red-breasted Merganser	
Mergus serrator	May 24
Rough-legged Hawk	
Buteo lagopus	May 6[3]
Marsh Hawk	
Circus cyaneus	May 21
Peregrine Falcon	
Falco peregrinus	May 22
Pigeon Hawk	
Falco columbarius	May 14[4]
Sora	
Porzana carolina	May 30
Yellow Rail	
Coturnicops noveboracensis	June 27[2]
Semipalmated Plover	
Charadrius semipalmatus	May 24
Killdeer	
Charadrius vociferus	May 24
American Golden Plover	
Pluvialis dominica	May 22
Black-bellied Plover	
Squatarola squatarola	May 24
Ruddy Turnstone	
Arenaria interpres	May 25
Common Snipe	
Capella gallinago	May 24
Whimbrel	
Numenius phaeopus	May 26
Spotted Sandpiper	
Actitis macularia	June 5
Solitary Sandpiper	
Tringa solitaria	May 29
Lesser Yellowlegs	
Totanus flavipes	May 23
Knot	
Calidris canutus	June 4
Pectoral Sandpiper	
Erolia melanotos	May 28
White-rumped Sandpiper	
Erolia fuscicollis	June 1
Baird's Sandpiper	
Erolia bairdii	May 24
Least Sandpiper	
Erolia minutilla	May 25
Dunlin	
Erolia alpina	May 24
Short-billed Dowitcher	
Limnodromus griseus	May 24
Stilt Sandpiper	
Micropalama himantopus	May 25
Semipalmated Sandpiper	
Ereunetes pusillus	May 24
Hudsonian Godwit	
Limosa haemastica	May 25
Sanderling	
Crocethia alba	June 2
Red Phalarope	
Phalaropus fulicarius	June 9
Northern Phalarope	
Lobipes lobatus	May 25
Pomarine Jaeger	
Stercorarius pomarinus	June 4
Long-tailed Jaeger	
Stercorarius longicaudus	May 26
Iceland Gull	
Larus glaucoides	June 2
Herring Gull	
Larus argentatus	May 5[3]
Bonaparte's Gull	
Larus philadelphia	May 24
Sabine's Gull	
Xema sabini	June 3
Arctic Tern	
Sterna paradisaea	May 26
Tree Swallow	
Iridoprocne bicolor	May 24
Common Crow	
Corvus brachyrhynchos	May 29
American Robin	
Turdus migratorius	May 23
Gray-cheeked Thrush	
Hylocichla minima	May 26
Water Pipit	
Anthus spinoletta	May 22
Northern Shrike	
Lanius excubitor	May 23
Myrtle Warbler	
Dendroica coronata	May 25
Blackpoll Warbler	
Dendroica striata	June 5
Northern Waterthrush	
Seiurus noveboracensis	June 5
Rusty Blackbird	
Euphagus carolinus	May 21
Pine Grosbeak	
Pinicola enucleator	May 14[3]
Hoary Redpoll	
Acanthis hornemanni	May 19
Common Redpoll	
Acanthis flammea	May 19
White-winged Crossbill	
Loxia leucoptera	June 5
Savannah Sparrow	
Passerculus sandwichensis	May 19
Slate-colored Junco	
Junco hyemalis	May 10[3]
Tree Sparrow	
Spizella arborea	May 25
Harris' Sparrow	
Zonotrichia querula	May 25
White-crowned Sparrow	
Zonotrichia leucophrys	May 25
White-throated Sparrow	
Zonotrichia albicollis	May 25
Lincoln's Sparrow	
Melospiza lincolnii	June 5
Swamp Sparrow	
Melospiza georgiana	May 26
Smith's Longspur	
Calcarius pictus	May 26

(1)First observed by P. Worth.
(2)First observed by Dr. F. Cooke near LaPérouse Bay.
(3)First observed by B. Knudsen.
(4)First observed by B. C. Lieff.

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Lesser Black-backed Gull at Churchill, Manitoba. A new bird for Canada

ON June 5, 1968, an adult Lesser Black-backed Gull, *Larus fuscus*, was observed on the large garbage dump just east of Fort Churchill, Manitoba. This bird was in the company of a large flock of other gulls, mostly Herring Gulls, *Larus argentatus*, and Thayer's Gulls *Larus thayeri*. Three Glaucous Gulls *Larus hyperboreus* were also present.

The gull, in breeding plumage, was observed as close as forty feet by C. Littlefield, B. Knudson, and both writers who are familiar with this species from Europe. Observations were made in good, diffuse light through seven and ten power binoculars and a fifteen to sixty power telescope. Clearly identifiable photographs were also taken (using a X 8 telephoto lens). All field marks were observed and are summarized below.

Overall Appearance – The bird was slightly smaller than a Herring Gull with a proportionally less massive head and bill.

Plumage Coloration – The mantle colour was a very dark gray although it seemed lighter than that of a Great Black-backed Gull *Larus marinus*. The wing tips were black with white mirrors. The remaining plumage was white.

Bill Coloration – The bill was similar in colour to that of the Herring Gull.

Soft Part Coloration – The eyes had pale straw coloured irises. The eye-ring was reddish. The legs and feet were a pronounced yellow.

What was presumably the same bird was seen at the nearby Cape Merry Dump on the previous day but due to bad light conditions no certain identification could be made. The gull was not seen again after the morning of June 5.

Although this species is an addition to the Canadian avifauna, there are at least eighteen North American records, thirteen of which are from coastal regions of the northeastern United States. Four specimens have been taken (Assateague Island, Maryland, 1948; Buffalo, New York, 1949; Rutherford, New Jersey, 1958; Enot, Indiana, 1962). In all cases where subspecific determination was feasible, the specimens have been found to belong to the British race, *graellsii*. Although it cannot be definitely said, this would seem to be the race of the Churchill bird, judging from the very dark gray mantle. Recent observations of the presumed *graellsii* race off South Greenland (Brown, 1968) serve to support this identification and to give some reason for this seemingly isolated Churchill occurrence.

Photographs and field notes have been deposited in the National Museum of Canada.

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Birds as Predators of Ticks in Canada

THE NOTE by Stelfox (1968) in this journal was a welcome addition to the scanty literature on known or presumed instances of the Black-billed Magpie (*Pica pica*) eating ticks. Green (1949) made similar observations, and was able to collect six magpies containing 3 to 16 engorged ticks. Probably most of these were *Dermacentor andersoni* but *D. albipictus* may also be present. Petrischeva and Zhmayeva (1949) identified 160 ticks of eight genera in the stomachs of 12 *Pica pica bactriana.*

From our own observations and ranch reports, there is little doubt that magpies, and possibly starlings and other birds, are not infrequent predators of *D. andersoni* on cattle, but no conclusive evidence of birds ingesting ticks from cattle in Canada is known to me. *D. andersoni* is of considerable economic importance, as a cause of paralysis in livestock and man, particularly in British Columbia (Gregson, 1956, 1966).

In British Columbia, and probably the montane regions of Alberta, *D. andersoni* is found mainly on the withers, neck and poll of cattle, whereas on the prairies, *D. andersoni* tends to attach on the underside of cattle (Davidson, 1941; Wilkinson and Lawson, 1965) and may be less accessible to birds. I would welcome further evidence of bird predation on ticks in Canada, particularly ticks on livestock, and would assist in identifying tick remains, which might be found in stomach contents or faeces.

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Two Rare Sculpins (*Cottidae*) New to the Marine Fauna of British Columbia

THE darter sculpin, *Radulinus boleoides*, Gilbert, 1898 and the frogmouth sculpin, *Icelinus oculatus*, Gilbert, 1891 are endemic to the eastern North Pacific, *Radulinus boleoides* was previously known only from California and the San Juan Islands, Washington, while *Icelinus oculatus* was known only from the coasts of California and Oregon. Bolin (1944) notes that both species are only rarely collected.

The British Columbia specimen of *R. boleoides* (an immature female 61.4 mm in standard length) was taken two

miles off Cape James, Hope Island, northern British Columbia at a depth of 50 to 65 feet by Drs. R. Rosenblatt and G. Cowan on a sand and gravel bottom. This extends the range of the species about 300 miles north. The specimen closely fits the detailed description of *R. boleoides* given by Bolin (1944) and therefore no description is included.

The British Columbia specimen of *I. oculatus* was taken in Pendrell Sound, Redonda Island, southern British Columbia by the Fisheries Research Board of Canada at a depth of 45 fathoms. Since the species is known from only 5 specimens, and the British Columbia specimen differs in a number of characters (mainly cirri number and distribution) a brief description is included. The description follows the format of Clemens and Wilby (1961). The morphometric ratios and meristic counts in parentheses are from 3 California specimens (including the holotype) and one Oregon specimen examined in the Stanford Natural History Museum.

Body heavy anteriorly, strongly tapered posteriorly. Head moderate 2.4 (2.4-2.6) into standard length. Mouth terminal, snout moderately steep and long 3.6 (3.5-3.7) in head; spines, nasal, moderate, sharp; preopercular 4, uppermost stout, with 2 or 3 sharp, upwardly directed spinules; gill membranes united, free from isthmus. Anus three-quarters distance between insertion of pelvic fins and origin of anal fin. Genital papilla of males large, bluntly conical. Fins: dorsal (2) × -15 (16-17); anal 13 (13-14); pelvic 1, 2, thoracic; caudal truncate. Lateral line gently decurved then straight. Scales ctenoid; on upper part of body in two rows close to dorsal fins, beginning below 3rd spine of spinous fin, ending behind second dorsal fin, 36 (30-36) scales in double row 4 in a single row extending beyond the double row; on lateral line 38 (37-39), rough. Cirri: along lateral line 8 (6-9), filamentous; on head; nasal (1), long, expanded at tip, eyeball 2 (1-2), long, slender; postorbital (1), long multifid; on suborbital stay (1), long; maxillary 3 (1). Colour (in alcohol): light tan, 3 dark saddles below dorsal fins, fine light reticulations below lateral line. Soft dorsal, anal, caudal and pectorals with dark stripes.

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Nesting of the Caspian Tern in Central-eastern Manitoba

Through the courtesy of Mr. Sam Waller I recently examined a set of two eggs of the Caspian Tern, *Hydroprogne caspia*, collected on a rocky reef in God's Lake, Manitoba, on July 10, 1963, by Lief Sunde. Mr. Sunde informs me (*in litt.*) that there were at least 16, perhaps up to 30, nests on one island.

Although this is the northernmost known nesting locality of the species in Manitoba, there is a possibility that more northern ones exist. This is suggested by an observation of Mr. Robert Frisch (MS) who saw a "great flock of Caspian Terns on a reef in Lake Waskaiowaka, northwest of Split Lake, Manitoba, in the middle of August, 1962."

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Occurrence of the Common Puffin on Lake St. Peter, Quebec

ON September 28, 1968, a hunter brought to my field headquarters at Nicolet, P.Q., a bird which he had shot but could not identify. Examination showed it to be an immature Common Puffin (*Fratercula arctica*). This specimen is in the Canadian Wildlife Service collection at Quebec City. Another immature specimen, taken on September 27, also on Lake St. Peter, was given by a hunter to Reginald Ouellet and is now in the collection of the Quebec Wildlife Service. A third specimen was reported to me on October 5 but it had been discarded and could not therefore be verified.

Although hurricane Frances passed near coastal areas of the Atlantic Provinces in late September no major weather disturbances were recorded in the Gulf of St. Lawrence which might have accounted for the above sightings.

Few previous reports exist for this species so far inland. In "The Birds of Canada" Earl Godfrey mentions only two, one near Ottawa (on the Ottawa River) in late October, 1881, and the other from Southwestern Quebec. The latter was recorded on October 30, 1949, by L. M. Terril, Province of Quebec Society for the Protection of Birds Annual Report for 1949, pp. 26-27 (Godfrey, pers. comm.).

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British Columbia Record of Skua in Terrestrial Habitat

ON 7 September 1968 at 07:45, the writers, accompanied by Hilde Hesse and Margaret Anne Dow, observed a large dark brown buteo-like bird standing in a plowed field at Canoe Pass, near Vancouver, British Columbia. When viewed through a 20X telescope, it was identified as a Skua, *Catharacta skua*. The yellow-buff of head and neck contrasted sharply with the dark brown back, and further contrast resulted from the lighter edges of a few feathers of the back and wings. The bill was slate-gray with a hooked black tip. We viewed the bird for 5 to 8 minutes from a distance of 100 meters; it looked about frequently but appeared undisturbed. It then ran a few steps and took flight; the broad whitish wing flash was clearly noted. The bird was almost as large as Glaucous-winged Gulls, *Larus glaucescens*, that it flew past; its shape and flight differed from those of the familiar Parasitic Jaeger, *Stercorarius parasiticus*, several being seen later the same day. The *Checklist of North American birds* (A.O.U., 1957) mentions two inland records, viz. Kansas City and the Niagara Gorge. The Skua is rare in British Columbia; it does not appear on the *Checklist of Vancouver birds* (B.C. Nest Records Scheme, Department of Zoology, U.B.C., 1962). Apparently most British Columbia records relate to sightings or specimens offshore or at offishore islands (C. J. Guiguet, pers. comm.; A.O.U., op cit; Godfrey, *The birds of Canada*. Natl. Mus. Canada Bull. No. 203, 1966; Munro and Cowan *A review of the bird fauna of British Columbia*. B.C. Prov Mus. Special Publ. No. 2 1947). Thus, the observation of a Skua, apparently normal and uninjured, on the mainland 250 meters from the water's edge is most remarkable.

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New Brunswick Specimens of the Field Sparrow and Laughing Gull

ALTHOUGH there have been many sight records of the Field Sparrow *Spizella pusilla* (Wilson) in New Brunswick, particularly in recent years, the presence of this species has not been verified with a preserved specimen. Squires (1952) reports the Field Sparrow as a casual summer resident. He also refers to a dead specimen found at Machias Seal Island in June 1950 and reported by Woolfenden (1952). In recent correspondence regarding the possible existence of this specimen, Dr. Woolfenden states, in part:

> "The Field Sparrow specimen that I found, to which Squires refers, consisted of the skull with rhampotheca and a few feathers. I compared these remains with specimens at the American Museum of Natural History and then discarded them. . . ."

It therefore appears that no specimen existed prior to October 30, 1968, when we saw a bird of this species at Pocologan, Charlotte County. The bird was collected in a field of long grass with scattered alder bushes beside the Bay of Fundy. The specimen, referable to the nominale race, is No. 736 in the collection of N. R. Brown. Data are as follows: sex ♀, wing 70 mm, tail 72 mm, exposed culmen 8 mm, tarsus 19 mm. The stomach contained remains of small seeds, probably of grasses.

Also on October 30, 1968, we observed three small gulls at Chance Harbour, Saint John County. The birds were flying over the mouth of a fresh-water stream entering the protected bay. One of the birds was collected and has been identified as a Laughing Gull *Larus atricilla* Linnaeus in second winter plumage. Squires (1952) refers to this gull as a very rare summer resident. He reports several sightings since 1862 but does not refer to existing specimens. In recent correspondence regarding this species Dr. Squires, Curator, Natural Science Department, New Brunswick Museum, writes:

> "Probably the Laughing Gull you collected is the first specimen taken in New Brunswick for which accurate data are preserved. Boardman had a specimen in his collection which we have here but it has no data on it although it was probably collected for him at Grand Manan."

The specimen is No. 737 in the above-mentioned collection. Data are as follows: sex ♀, wing 331 mm, tail 140 mm, exposed culmen 39 mm, tarsus 55 mm. The stomach was filled with small shrimp.

We wish to thank W. Earl Godfrey, Head, Vertebrate Zoology Section, National Museum of Natural Sciences, Ottawa, for confirming our identifications of the two specimens.

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Notes on the Blue Fox of Rat Island, Alaska

THIS report deals with the blue fox, a color phase of the Arctic fox (*Alopex lagopus*), on Rat Island in the Aleutian Islands, Alaska. Fur trappers transplanted blue fox to certain Aleutian Islands early in the 1900's, but these islands were seldom revisited after market values declined in the 1930's. Trappers resident to Atka Island transplanted foxes to Rat Island about 1921 (Gray, 1939). The common rat (*Rattus norvegicus*), became established after a Russian sailing vessel was wrecked there about 1750. Sea otters (*Enhydra lutris*), harbor seals (*Phoca vitulina*), and sea lions (*Eumetopias jubata*) are the only mammals indigenous to the island. The detrimental effect the fox eventually had on wildlife, particularly the Aleutian Canada goose (*Branta canadensis leucopea*), as reported by Murie (1959), was the stimulus for the U.S. Bureau of Sport Fisheries and Wildlife to collect information basic to assessing requirements of a predator control program.

Rat Island lies approximately 178° 18′ E. longitude, 51° 48′ N. latitude and includes 25 square miles of tundra habitat bordered by a rugged coastline; maximum length and width is 13 by 3 miles respectively.

A total of 197 foxes was captured alive during periods collectively extending from June through August, 1961-62 at four areas two of which were trapped simultaneously. Foxes frequented beaches and headlands and were easily taken in steel traps placed near sea mammal carcasses, which had been cast ashore, or at baited sets. Animals were tagged in one ear and individually marked in the other with colored plastic affixed by a jessed knot before being released.

The Rat Island fox population was estimated in 1962 at 247 ± 28 (fiducial limits, α 0.05) based on analyses of trapretrap data using the Lincoln Index (Wildl. Invest. Tech., 1963). Sex ratios of adult and juvenile segments were essentially even and juveniles comprised 30% of the total number of fox captured which indicated reproduction was low considering the reproductive potential typical of canine species. Further support in this respect was obtained by making observations at 16 natal dens where counts averaged 2.8 pups per litter and ranged from 1 to 5 pups. Arctic fox litters reportedly range from 1 to 14 pups in size (Palmer, 1954). Whelping peaked in June.

Beach fringes and headlands were used as denning areas. Those of the headlands extended into the shallow turf to a depth of 3 feet. Dens along beaches were constructed beneath natural rock formations or driftwood piles and had more extensive depth and several entrances. The terminal extremity of each den generally contained a bed, 4 inches in thickness, composed of vegetative material and fox fur.

The extent that natal den sites were defended varied appreciably among individual animals. Defensive behavior usually amounted to holding an intruder at bay near the periphery of the denning area. Fox pups abandoned dens of headland areas during July to forage along nearby beaches as family groups.

The foxes' home range was relatively sedentary although no topographic barriers existed on Rat Island. A total of 59 foxes was recaptured at the same locale in 1962 but only 7 of these disclosed any appreciable movements. They averaged about 4 miles between capture locations with minimal and maximal distances of 2 and 7 miles respectively.

Summer food items consisted mostly of amphipods (*Orchestia* spp.) and kelp pupae (*Fucellia* spp.) that inhabited decomposing kelp piles found along beaches. Of 36 scat examinations, these items were found in 90% of the specimens. Foxes exhibited little inclination to feed on sea

mammals, fowl, or rats during the summer on Rat Island. Although bird life was scarce on Rat Island, the presence of large bird colonies on other Aleutian islands presumably influences preferences. The bald eagle (*Haliaeetus leucocephalus*) was the only apparent predator as evidenced by the discovery of four skins of fox pups in one of the four nests present on Rat Island.

In summary blue foxes were live trapped and tagged for behavior observations in respect to whelping, feeding, movement and population studies on an undisturbed Aleutian Island. All the denning occurred near the beaches with the peak occurring in June. Summer food items consisted mostly of amphipods and kelp fly pupae. The only apparent predator is the bald eagle.

Acknowledgment

I wish to thank Richard J. Hensel, Kodiak National Wildlife Refuge, and other co-workers for reviewing this manuscript.

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The Ground Dove in Canada

On 29 October 1968, Mrs. John E. Freeman in the company of Mrs. D. Reynett and Mrs. R. Sutton, found a dead Ground Dove, *Columbigallina passerina* on a road one and one half miles from the town of Red Rock, Thunder Bay District, Ontario. This specimen comprises the first record of a Ground Dove in Ontario and in Canada. The bird was subsequently donated to the Royal Ontario Museum by Mr. and Mrs. Freeman and is now specimen number 103396 in the collection of the Department of Ornithology.

The following measurements were taken on the specimen: bill (culmen), 11.1 mm.; wing (chord), 89.6 mm.; tail, 59.6 mm. Although mensural characters were not conclusive, on the basis of plumage characters outlined by Ridgway (1966, Birds of North and Middle America, U.S.N.M. Bull. vol. 50, no. 7, p. 398) and in comparison to specimens in the collection of the Department of Ornithology, the specimen was assigned to the eastern race, *Columbigallina p. passerina.*

North of Mexico this form breeds from southeastern Texas east through the Gulf States to South Carolina. Casual or accidental records are known from as far north as Kansas (R. F. Johnston, 1965. A Directory to the Birds of Kansas. U.K.M.N.H. Misc. Publ. 41); Iowa (C. H. Pangburn, 1922. Sight Record of a Ground Dove in Iowa. Auk, vol. 39, p. 568); Michigan (T. A. Petts, 1966. First Record of Ground Dove in Michigan. The Jack Pine Warbler, vol. 44, no. 4, p. 176); New Jersey (W. Stone, 1908. The Birds of New Jersey. p. 155); and a hypothetical record for New York (E. M. Reilly & K. C. Parkes, 1952. Prelim. Annot. Checklist of Birds of New York State). However, there is no previous record of this species in any part of Canada.

Although the bird was found on the road, post-mortem examination disclosed

no broken bones or hemorrhaging. However, subcutaneous fat deposits were absent and the carcass appeared to be emaciated. The temperature (at Armstrong) ranged from 16 to 45 degrees F. between 22 and 29 October. Weather data for several days prior to 29 October showed that a low pressure area moved west to east through Ontario (centered in the Nipigon area on 28 October) and concurrently there was a high pressure area in the Caribbean. A ridge extended between these two pressure areas with a resultant northerly flow of warm air into Canada. This weather front may have been instrumental in carrying this bird into northern Ontario.

We wish to thank Mrs. John E. Freeman for her alertness and interest in taking this specimen; Mr. Freeman for transporting the specimen to Toronto; and to express our appreciation to the Freemans for donating the specimen to the Royal Ontario Museum. Weather data were obtained from the Meteorological Branch of the Department of Transport of Canada, in particular Messrs. Manning of the Climatology Branch, and Mowat of the Meteorology Branch.

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A Record of The Virginia Rail from Banff National Park, Alberta

A VIRGINIA RAIL, *Rallus limicola*, was recovered May 1, 1968, on Bow Pass in Banff National Park, (approximately 51°40′ North–116°30′ West, elevation 6,878 feet), by H. L. Jennings, District Park Warden. The bird had apparently struck a single strand telephone line which crosses the Pass.

Winter conditions prevail at Bow Pass in early May and at the time the bird was recovered, several feet of winter snow still covered the ground. Presumably the bird became lost during a storm and was blown far off its normal course.

The few records of the species in Alberta are confined to the central and eastern portions of the Province according to Salt and Wilk (1958). To my knowledge none have previously been reported from the Rocky Mountains proper. Godfrey (1966), shows the Virginia Rail breeding in eastern and central Alberta and in the Columbia River Valley of southern British Columbia. Both areas are well over a hundred air miles from Bow Pass.

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Observation of Wheatear Near Schultz Lake, Keewatin District, N.W.T.

THE recorded breeding range of the Wheatear in North America shows a wide gap between the range of the European Wheatear (*Oenanthe o. oenanthe*)

and that of the Greenland subspecies (*Oenanthe o. leucorhoa*). The map of the breeding distribution of the Wheatear shown by Godfrey (1966) indicates that most of the Yukon Territory falls within the breeding range of the nominate race. The Greenland subspecies in Canada has been recorded in eastern Labrador, most of Baffin Island, the southern portion of Ellesmere Island, the extreme northwest corner of arctic Quebec, and the northwest tip of Southampton Island. The latter area includes White Island, where breeding was established by Dr. N. G. Smith in 1960 (Godfrey, pers. comm.).

In this context it is of interest to report the following observation of a Wheatear about 375 miles west of the nearest known breeding area on White Island.

On July 21, 1968, while engaged in field work related to a study of pesticide residues in birds, Richard Fyfe and I observed a Wheatear just east of Whalebone Hill on the north shore of Schultz Lake, N.W.T. The geographic location, 64° 46′ N., 97° 46′W. is about 225 miles inland from Hudson Bay.

The bird was observed near the base of one of the weathered and disintegrating granitic escarpments, which rise prominently above the gently rolling, stony tundra in that area. The bird, which appeared to be an adult male, was observed through 7 x 50 binoculars at fairly close range and although its restless and "shy" behaviour prevented us from making extended studies, the black face mask and the black and white pattern of the tail were clearly observed. The Wheatear's habit of frequently spreading and flipping its tail, its low, short flights over the rocks and its "check-check" call, somewhat resembling that of a Red-winged Blackbird were noted. Twice we were able to approach the Wheatear to within shotgun range but, partly due to the bird's restlessness, our efforts to collect the bird failed. Since the Wheatear returned frequently to the same rocky outcrop and tended to remain in the area where the initial observation was made, we strongly suspect it may have been nesting nearby.

Our observations and those made by Dr. N. G. Smith suggest that the wide gap between the two ranges of the Wheatear in North America is being narrowed.

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Ernie Kuyt and R. W. Fyfe

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Accepted October 14, 1969

Some Interspecific Intolerance Between Barrow's Goldeneye and Other Duck Species During Brood-rearing

In the course of conducting a waterfowl survey for the Canadian Wildlife Service in the Cariboo Parkland region of British Columbia in 1968, two noteworthy incidents of interspecific intolerance involving Barrow's Goldeneye, *Bucephala islandica*, were observed. The first took place on July 12 on a small pond of seven acres. This was occupied by several broods of ducks, including an advanced brood of Barrow's Goldeneye. A downy brood of Blue-wing Teal, *Anas discors*, was observed to move toward that part of the pond where the Goldeneye brood was feeding. Neither observer witnessed what initiated the conflict, but splashing and distress calls attracted our attention. The Goldeneye female had

caught a young teal in her bill and was shaking it vigorously, while the female teal attacked the Goldeneye female in turn. At the end of the brief skirmish the young teal floated dead on the surface. None of the other downy teal were seen during a further half hour of observation.

The second incident took place on July 21 and involved advanced broods of Bufflehead, *Bucephala albeola,* and Barrow's Goldeneye, each with eight chicks. Before the attack the Goldeneye female assumed the 'crouch and the laying-neck-on-the-water' posture (Myres, 1960). The attack was directed against the hindmost member of the Bufflehead brood as that brood swam away. The Bufflehead female responded immediately by attacking the Goldeneye female. The fight ended with the broods widely separated.

Similar incidents have previously been recorded (Myres, 1960; Sugden, 1960), and the subject has been reviewed briefly by Erskine (1960). Of the two incidents described here it is interesting that mortality was only associated with the downy brood. Erskine refers to a similar incident in which a Bufflehead brood less than three days old disappeared following an attack from a female Goldeneye.

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Accepted June 2, 1969

NEWS AND COMMENT

ENDANGERED WILDLIFE IN CANADA — 1970

The year 1970 will mark a turning point in the awareness of thousands of Canadians concerning the species of Canadian wildlife that are now in danger of becoming extinct. First, the next issue of the Canadian Field-Naturalist will contain a series of 4 papers on endangered vertebrates of Canada written by experts in their field, documenting case histories on mainly scientific grounds Secondly, and much more important, the theme of National Wildlife Week, April 5-11, 1970 will be "Endangered Wildlife in Canada." National Wildlife Week is sponsored by the Canadian Wildlife Federation in co-operation with provincial resource departments. During the week the CWF will co-ordinate a nation-wide program. It is expected that over 100,000 posters and classroom lessons as well as 30,000 illustrated booklets on our endangered wildlife will be distributed to schools across Canada. A television clip lasting 60 seconds will also be made available to TV stations across the country. The purpose of National Wildlife Week, 1970, is not only to demonstrate which species are endangered but to bring home to people some of the fundamental forces that now threaten many of our wild animals and birds.

EDITOR

Some Facts About Falconry in Washington

The Northwest Falconry News, Volume 4, No. 1, 1969, publication of the Northwest Falconry Association, reports that in the state of Washington alone in 1967 and 1968, the number of "hawks" captured by falconers were at least: Redtail 39, Prairie Falcon 24, Coopers Hawk 19, Sparrow Hawk 27, Peregrine Falcon 4, Goshawk 6, Ferruginous Hawk 3, Black Merlin 1, Sharp-shinned Hawk 2, Swainsons Hawk 4, American Rough-legged 1. Some of the Peregrines, Prairie Falcons and Goshawks were from domestic reproduction.

A total of 195 falconry permits were issued in 1968, authorizing the holding of a hawk or hawks. This is a large increase over 1967 when 128 permits were issued.

EDITOR

Directory of Canadian Botanists

A "DIRECTORY OF CANADIAN BOTANISTS, 1969" has recently (August 1969) been published by The Canadian Botanical Association, in co-operation with The Canadian Society of Plant Physiologists and The Canadian Phytopathological Society. It contains approximately 950 names; the Canadian members of the above societies. The botanical interests of most persons are indicated.

Copies may be obtained for $1 (individuals and libraries) or $100 (commercial users) from the Treasurer of The Canadian Botanical Association: Dr. Wm. Illman, Dept. of Biology, Carleton University, Colonel By Drive, Ottawa 1, Ontario.

Canada Joins International Conservation Union

CANADA has joined the INTERNATIONAL UNION FOR CONSERVATION NATURE AND NATURAL RESOURCES (IUCN).

The IUCN, with headquarters in Switzerland, was set up in 1948 to promote the preservation and wise use of the world's resources. As an international, non-political body, it has the support of such agencies as the Food and Agriculture Organization, United Nations Educational, Scientific and Cultural Organization, Economic and Social Council of the United Nations, and the Council of Europe.

In making the announcement the Honorable Jean Chrétien, Minister of Indian Affairs and Northern Development said that as one of some 30 member states, Canada will have two votes at IUCN general assemblies, and will receive all IUCN publications. In addition, it will be able to draw on the scientific, legal, and administrative experience of conservation experts associated with IUCN.

Annual dues of $3,000 have been paid by Mr. Chrétien's Department, which manages a large conservation and scientific research program through its Canadian Wildlife Service and National and Historic Parks Branch.

Canadian membership was ratified at the 10th General Assembly held in New Delhi, India, from November 24 to December 1. Dr. Ward Stephens, Western Regional Director of the Canadian Wildlife Service, and Mr. John I. Nicol, Director of the National and Historic Parks Branch, represented Canada at the assembly while Mr. Harold Eidsvik attended as an observer.

The IUCN is financed mainly by the World Wildlife Fund and membership fees. Sovereign states, government departments and services, and independent national associations and institutions are eligible to join. In addition, individuals can support it through membership in the "Friends of IUCN".

Through its Ecology, Education, National Parks, Legislation and Administration, Survival Service, and Landscape Planning Commissions, IUCN studies and advises on such problems as maintenance of natural habitat in urban, industrial or resort areas, and setting up of national parks or reserves.

It also makes representations directly to governments to point out threats to their natural resources. For example, IUCN intervention prompted Sweden, Norway and Finland to strengthen protective laws for arctic species.

At the meeting the IUCN decided to hold its 1972 meeting in Canada.

Adapted from a Press Release, Department of Indian Affairs and Northern Development, Ottawa.

LETTERS

A PLEA FOR FEDERAL PROTECTION OF THE PEREGRINE FALCON. II.

PLEASE allow me to comment on a paper which appeared in the Canadian Field-Naturalist, Vol. 83, No. 3, titled: "Regional population declines and organochlorine insecticides in Canadian Prairie Falcons." There is a mistake in the following sentence on page 194: "The number of known occupied Peregrine Falcon territories in area D had also declined from six in 1960 (Dekker, 1967) to one in 1968. . . ." These six territories were not located in area D, where the insecticide residues in Prairie Falcon eggs were found to be highest of the 4 study areas, but in area F for no such figures are given. Incidentally, these six nests were subject to a great deal of human disturbance, as was stressed in my paper "Disappearance of the Peregine Falcon as a breeding bird in a river valley in Alberta" (Blue Jay 25: 175-177).

Human disturbance, accidental as well as intentional, was also commonplace along other Alberta rivers. Breeding Peregrines near centres of population were the first to go. Along the North Saskatchewan between Edmonton and Devon, the birds were extirpated long before neighbouring populations showed any signs of decline. In 1969 only 3 nests could be found in the province. R. Fyfe, of the Canadian Wildlife Service and currently studying raptors and pesticides in the West, informed me that 2 of these nests were robbed of young, one completely, the other partly. It is a pity that the element of human disturbance was not mentioned in the recent study on Alberta's Prairie Falcons, even more so since DDE levels found are much lower than those reported from the Canadian North, where the reproductive success of Peregrines is considered normal, in spite of a high rate of contamination.

Especially now, when recent regulations restricting the use of DDT in North America allows some hope that such birds as the Peregrine may be saved in the nick of time, all additional dangers to their continued survival should be carefully assessed. Some of these dangers are quite apparent when one studies the literature. R. Fyfe, who shares my deep concern in this matter, has privately expressed agreement with my view that the difference in North American Peregrine populations that have disappeared and those that are still doing well, is not a difference in the level of pesticide contamination but a difference in the rate of human disturbance. Of course, I do not imply that the birds nesting in wilderness areas are safe in spite of pesticides. On the contrary, if the current high levels are allowed to build up, the species is ultimately doomed. But again, as there is some hope that this fate may be averted, there is now all the more reason to halt the occurrence of human disturbance in remote areas, which has been growing ever since Peregrines became extinct in more accessible regions. In a previous letter concerning this subject, which appeared in this publication (Vol. 83, No. 1, page 64) I erroneously stated

that the taking of Peregrines for falconry purposes was not allowed in the Yukon and the Northwest Territories, as I was led to believe by a C.W.S. employee stationed in Edmonton. After writing to the Territorial Gonvernments I got the following information:

During the 1969 season 6 permits were issued in the Yukon free of charge, for a maximum of 8 birds. In the Northwest Territories, from 1967 to 1969, 17 permits were issued, covering 43 Gyrfalcons and 18 Peregrines. In 1965 one well-known west-coast falconer reportedly took 16 Peregrines, half of that number illegally. The quota in 1969 was 40 birds at $50.00 a piece. There are indications that this price may be raised considerably for Gyrfalcons, and that the Peregrine will be completely restricted in 1970.

Though the take of Peregrines seems rather small, the disturbance factor may be important, especially since many permit holders visit a number of eyries for study purposes. There are also risks involved in professional research which go beyond the occasional collecting of birds and eggs. Eyries are visited two or three times per season, and sometimes it takes several hours from the time the party arrives at the nesting cliff until the birds are finally left alone. Since Peregrines are conspicuous birds and nest on exposed locations, few pairs escape attention. The policy of both the Yukon and the Northwest Territories in the issuing of permits is one of restraint and is under constant review. Permits are issued only to reputable falconers. As a letter from the federal minister of Indian Affairs and Northern Develoment informs me, all applicants are screened by R. Fyfe, who is a falconer himself.

In the United States, during the past year, the plight of the Peregrine was the subject of four conferences, respectively sponsored by the National Audubon Society, Cornell University, the American Falconers Association and the Raptor Research Foundation. Sincere concern was expressed by all involved. The falconers, among them such Peregrine authorities as Dr. Tom Cade and Dr. Jim Enderson, agreed that the Peregrine should be protected from the ever-increasing pressure of human disturbance, but they appeared to favour a restrictive system of permits for falconry and "scientific" purposes. The latter probably includes attempts at breeding in captivity, which have not been successful so far.

A group of American and Canadian scientists, that met at Cornell University in November of 1969, drafted a resolution recommending continent-wide protection for the Peregrine. A letter to this affect was sent to all governments involved. The National Audubon Society was concerned about the capture of migrant falcons along the coasts of Florida, Texas and elsewhere. In a letter to me, R. C. Clement, vice-president of the organization recognizes the role played by direct human disturbance in the extirpation of Peregrines on the continent and the need for total protection, which is now "a matter of finding the proper technique . . . as legislation is of course always slow".

To assist the American organizations in achieving their objective, the time has come for Canadian ornithologists to express their views to the proper authorities. After all, Canada is the birthplace of the majority of the Peregrines which are still left in the Western World.

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REVIEWS

Flora of Alaska and Neighboring Territories: a Manual of the Vascular Plants

By Eric Hultén. Stanford University Press, Stanford, Calif. 1968. xxiii + 1008 pp. illus., $35.00 (U.S.).

Alaska lies at the crossroads of circumpolar plant distribution. A flora of Alaska is thus a most important contribution to botanical knowledge. Professor Hultén's new flora of this region is the culmination of a lifetime of untiring work on plants of circumpolar and arctic distribution which began with his Flora of Kamchatka (1927-1930) and was continued through Outline of the History of Arctic and Boreal Biota During the Quaternary Period (1937), Flora of the Aleutian Islands (1937), Flora of Alaska and Yukon (1941-1950), The Amphi-Atlantic Plants (1958) and The Circumpolar Plants (1964). He must be congratulated for having brought this monumental work to completion.

This book will be an essential tool for anyone working on the vascular plants of northern regions. It is unique in that two distribution maps are provided for each of the 1,735 species and subspecies treated. One is a detailed dot map for the Alaska-Yukon and adjacent area of Siberia, British Columbia and Mackenzie District, and the other, outlining the circumpolar distribution, is similar to those used in the latter two works mentioned above, but is necessarily much smaller because of the format and thus more difficult to consult.

New collecting in the region covered by the dot maps has already made some of these maps out of date; e.g. *Lycopodium alpinum*, *Cardamine microphylla* (*C. minuta*) and *Eritrichium splendens* among others have been reported from the Richardson Mountains of northwestern Mackenzie District, and *Agrostis exarata*, *Claytonia tuberosa* and *Chrysosplenium Wrightii* from the Mackenzie Mountains, since the book went to press, but this does not lessen the value of these maps. It is the inevitable result of further field work in regions previously poorly explored botanically. Further collecting will also inevitably bring together some of the disjunct regions shown on the circumpolar maps. In some cases we wonder if the black lines delimiting the distributions might not be adjusted, e.g. the black line on the dot map (p. 316) for *Cypripedium calceolus* ssp. *parviflorum* encompasses a large part of central Yukon in order to include a collection from near the Alaska-Yukon border, while on the map for *Dactylorhiza aristata* (p. 318) two dots on the south coast of Alaska are separated from the main Alaska Peninsula - Aleutian Island distribution when they might perhaps just as readily have been included.

Throughout the book two taxa are treated on each page, except where lengthy keys restrict this practice. Descriptions are more or less brief, and are accompanied by notes on habitat which are based on the author's extensive field studies, and comments on the differences between American and Alaskan subspecies and their Eurasian counterparts. Line drawings by Mrs. Dagny Tande-Lid of Oslo are in the margin beside the accompanying text. There are no detailed drawings, but the sketches presented do provide a most useful aid to identification.

Dichotomous keys to families, genera, species and subspecific taxa are provided. The keys to families and genera are a most useful improvement over the Flora of Alaska and Yukon for the amateur or for botanists unfamiliar with all the genera of the region. One serious omission which has been noted is that the generic keys which immediately follow the family key at the beginning of the book do not have the individual genera numbered nor are page references given for the genera in the following text, a distinct disadvantage if the user is unfamiliar with the taxonomic sequence followed in the book.

Because of the excellent presentation, the book is a delight to use. A considerable part of its 5½ lb. weight might have been eliminated if the large margins had been trimmed and other large spaces had been closed up. Although the book would thus have been smaller and therefore easier to take into the field, this would have made it less easily usable.

An introduction presents general information on the region such as climate, geological features, plant collection and distribution, comments on races, apomicts, hybrids and endemics, and a list of additional species which might still be discovered. There is a center insert of eight pages of beautiful color photographs, some depicting the terrain and others individual plants. Also included is a glossary of botanical terms, an annotated list of all authors of taxa appearing in the book including authors of synonyms, a list of persons for whom taxa have been named, an eight-page bibliography, and indexes to common and scientific names.

The price of this volume will probably preclude its purchase by all but the most interested of individuals, although it is well worth the $35.00 price tag. It will, however, be a must for all botanical libraries and institutions in the northern hemisphere.

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Eighty More Land Birds to Know

By BARRY KENT MACKAY. The Book Society of Canada Ltd., published by Saunders of Toronto Ltd., 8 color plates, iv + 83 pp. (1968). Published in February, 1969. $2.95.

This is the third in a series of field guides to a selection of Canadian birds, The first eight pages consist of color illustrations of the species treated. Each bird is covered by a single page in the text, which includes a line drawing to indicate key field marks. The eighty species are briefly discussed under the headings: Appearance, Voice, Habitat, Range, Nesting, and Food. A short descriptive paragraph completes each treatment.

Unfortunately one of this volume's great difficulties appears immediately. What is the purpose of the book? Is it a field guide for naturalists and bird-watchers in the Great Lakes area, or do beginning birders use it in identifying frequently encountered Canadian birds? The author and publisher state conflicting views; neither is successfully supported by the book.

No beginner should use a field guide that deals with only eighty species. Would not great confusion and discouragement result upon observing one of the many species not covered? Surely we cannot expect birders to carry three books into the field—yet with this series, one must. The beginning or casual birder would be much better off to invest another dollar and purchase a complete field guide of lasting value. (The Peterson "Field Guide to the Birds" would be ideal).

MacKay's illustrations are generally poor, as is the key to spring plumages. There is one pointless color plate of fledgling birds—these are beyond the scope of the beginner. For birders in the Great Lakes region, of what use is the illustration of a fledgling Gray-cheeked Thrush? Furthermore, I can see no earthly reason for including such extra-limital species as Wheatear, Sprague's Pipit and Bullock's Oriole.

Status has been ignored, leading the unaware into such false conclusions as that Blackpoll Warbler and Gray-cheeked Thrush are equally common migrants through the area. A number of small but important technical errors are evident (e.g. the range of the Orange-

crowned Warbler as compared with that in Godfrey's "Birds of Canada").

One of the most critical omissions is that of a recognizable order. In the absence of the established A.O.U. order (with which every beginning birder should become familiar), one is forced to make constant reference to the index. In the field, much precious time would be lost.

All this is not to say that the book is useless. There are several worthwhile points in its favour. The method of denoting important field marks by the use of titled pointers (à la Peterson – but improved upon) is very successful. The descriptive paragraph concluding each species account is well done–light, readable and generally informative. The General Appearance sections are good, and further, I find the whole treatment of the Winter Wren a positive delight.

However, the image remains one of a generally unimaginative inconsistent effort. I find it ill-planned, poorly executed and rather vague. Nevertheless, MacKay has shown considerable potential in this work. Perhaps unburdened by the confines of continuing a series he did not originate, he will be able to draw on this talent more successfully next time.

Regretfully, I find it impossible to recommend "Eighty More Land Birds to Know" to the beginning or casual birder.

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The Sockeye Salmon, *Oncorhynchus nerka*

By R. E. FOERSTER. 1968. Fisheries Research Board of Canada Bulletin 162: xv + 422 pp., 6 plates (2 colored), 96 text-figures. $8.00 from Queen's Printer, Ottawa.

Since the original description over 150 years ago and particularly during the last 50 years, biologists around the periphery of the North Pacific have been contributing information on the sockeye salmon, *Oncorhynchus nerka*. Foerster has integrated these contributions with his own life-time studies to produce a monograph of the first order.

The sockeye has an intriguing life history. Generally the eggs are deposited in redds during late summer and autumn in tributaries or outlets of lakes. After hatching in early spring, the young spend a year or more in the lake before descending to the sea. One to five years are spent in the sea, with some sockeye migrating as far as the Aleutians. The mature adults return to their natal stream, spawn, and die. In some populations the young may omit the period of lake residence and go directly to sea. Other populations remain permanently in freshwater and are called kokanee. The unravelling of this story has taken many years and there are still problems unsolved. Problems that are discussed include: How do sockeye fry find their way through large lakes on their way to the sea? How does the adult sockeye navigate from mid-ocean to the estuary and recognize its natal stream?

Following an introductory chapter with a useful summary of the life history, origin and evolution, are chapters on the fishery, escapement, reproductive success, upstream migration, spawning, lake residence, marine phase, stock identification, artificial propagation, and hybridization.

The style is terse because of the high density of information, but always clear. Quotations from original papers enrich the text and give fresh vignettes of fry migration, spawning, etc.

Although material is drawn from many sources (over 300 references are included), there is a real unity to the text, a tribute to the author's knowledge and grasp of the material. Many references up to 1962 and a few to 1966 are included. Literature of other countries is not ignored and American,

Japanese, Russian as well as Canadian (a not unimportant segment is Canadian) sources are used. The author further draws upon several unpublished manuscripts. The material from these sources is not simply compiled, but is critically evaluated and integrated.

The volume tries to bring together all that is presently known about the sockeye. A useful addition would have been a section outlining what is not known about the sockeye. From the absence of sections on anatomy, embryology, behavior and physiology, *per se*, one infers that little is known of these aspects. The author notes the absence of winter observations in the North Pacific. Much of the information collected relates to reproduction, survival, growth, and stock identification, management-oriented aspects of biology. These sections, comprising the bulk of the book, are masterfully done. Surprisingly little mention is made of dams and fish ladders. The section on origin and evolution is not as strong as the others. Rounsefell (1962, *Relationships among North American Salmonidae*. Fish Bull., U.S. Fish Wildl. Serv. 62) might have been referred to here. The reviewer would like to have seen included an overall distribution map of the species. Although the table of contents is detailed, an index would have been useful because the text is so packed with information.

For the zoologist this book will be a mine of information, to the fishery biologist an indispensible tool, and to the interested naturalist a storehouse of fascinating facts. It is a work of which the author and the Board may well be proud.

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A Place for Everything

By DAVID MUNRO. Canadian Broadcasting Corporation, Toronto. iv + 108 pp., 304 photos (19 in color), 1968. $3.95, from CBC Publications, Box 500, Terminal A, Toronto 1, Ont.

This is a picture book for adults. The excellent text and the carefully planned relationship between text and photographs give a comprehensive introduction to ecology with particular reference to Canada. The author succeeds in making easily understood the complex ideas of environment, of the relation of environment to man's population explosion and what that explosion means in terms of environmental pollution.

The name of the book derives from the tidy housekeeper. The pictures and text explain why there is a place for everything and why man should be very careful that his actions do not upset the housekeeping arrangements of an area, a country, or the world. If he is not careful, everything will not have a place and some things will be lost forever, with far-reaching effects on man's world. At the worst he, himself, will have no place.

For those Canadians who tend to forget the basic importance of good soil and clean water, the book will be a forcible reminder. For all others, it will recall the pleasantness of nature and the need to ensure its preservation for all time, for our own good.

The paragraph on hunting illustrates the author's philosophy:

> Hunting does no harm to animal populations so long as it helps keep the numbers of the hunted at a level their habitat can support. If no animals were killed by hunters, most would soon die by some other cause.To hunt is a reason to learn about the lives of the hunted and the areas they frequent. To hunt is to become alert and observant, to learn to move carefully and quietly, and to become truly aware of the out-of-doors. But to hunt without respect for and knowledge of

the hunted; to hunt carelessly and noisily, crippling animals, littering and damaging their habitat is to destroy the experience you are looking for.

The book is beautifully and subtly arranged, the photographs well produced and the text typical Munro, easily read, logical and lucid.

V. E. F. SOLMAN

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The National Forests of America

By ORVILLE L. FREEMAN and MICHAEL FROME. G. P. Putman's Sons, New York in association with Country Beautiful Foundation, Inc., Waukesha, Wis. and Longmans Canada Limited, Toronto. 1968. 194 pp., illus. $16.25.

This is a large book with striking scenic photographs, many of them in color, of the National Forests and National Grasslands in the United States. The text by Orville L. Freeman, until recently Secretary of Agriculture, and Michael Frome is a compact commentary on these reserves, their characteristics and their uses.

It is significant of changing public attitudes toward native landscapes that the book emphasizes the recreational the aesthetic values of the forests rather than marketable commodities such as lumber and beef. A naive reader might suppose that the chief aim of the National Forest System is to enhance the enjoyment of the tourist, the hiker, the camper, and the skier. True there is mention that about 25,000 timber sales yield close to $140 millions annually, and that about 60,000 farmer-ranchers graze livestock in the reserves, but such statistics are given relatively little space. Furthermore, the increasing alienation of forest land as Wilderness Preserves is recorded without a tremor as if it were the most natural thing in the world, from all of which one can conclude that the authors have not been overly influenced by traditional forestry. A short "Epilogue" by the Chief of the Forest Service, Edward P. Cliff, gives a professional's appraisal of what the National Forests are all about, and here we glimpse a truer picture of multiple use and its implications for "natural" landscapes.

The fact that the book is slanted to the beauties of mountain, river, forest and grassland rather than to resource management detracts not at all from it, for by what other means can the interests of humanity-at-large be caught and held? Doubtless the real future of much of the North American wildland resource lies with amenity and recreation. In Canada too the trends are evident, although progress in setting up new national parks, natural areas and wildernesses is disappointingly slow.

The introduction traces the history and development of the Reserves and of the Forest Service. Then follow pleasingly illustrated chapters on trees and forests, wilderness areas, scenic roads, wildlife, recreation areas and interpretation programs, youth-training programs, scenic rivers, hiking trails, winter sports, grasslands, scenic Alaska, and historical monuments. Included are tables and maps, providing information in summary form on National Forests, Wildernesses, Primitive Areas and other reserves of special interest. A few small errors were noticed in the common names of animals; a toad is called a tree frog on page 64, a damselfly is a dragonfly on page 144, and on page 169 the swans look remarkably like geese.

I found that book attractive and informative, and can recommend it to nature lovers and park enthusiasts.

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Manual of the Vascular Flora of the Carolinas

By ALBERT E. RADFORD, HARRY E. AHLES and C. RITCHIE BELL. The University of North Carolina Press, Chapel Hill. 1968. lxi + 1183 pp., illus. $19.75 (U.S.).

Students of the vascular plants of the southeastern United States and of the Carolinas in particular will be more than pleased with the appearance of this new flora. It is the only descriptive flora of North Carolina and South Carolina since "Flora Caroliniana" by Thomas Walter was published in 1788, although the regional manuals by J. K. Small did include the area.

The book is written in the standard fashion with keys to families, genera and species, family, generic, and species descriptions, notes on habitat, abundance, flowering time, distribution within the Carolinas, and distribution by state in the southeastern U.S.A. Synonomy is given where the names used for taxa differ from other manuals, with the useful suffix of an initial to indicate the reference, e.g. F (Fernald), S (Small). A total of 3542 taxa are treated. Some additional taxa which have been reported for the area but for which no voucher herbarium specimen could be found are briefly described at the end of the genus, but are not keyed out. Chromosome numbers have mostly been taken from Delay (1951), Darlington and Wylie (1955) and Cave (1955-66); numbers followed by a raised small ^{c} indicate that the count was from material gathered in the Carolinas.

Small Carolina distribution maps are provided nearby to give the county occurrence for all taxa which are known to occur in six or more counties; where a taxon occurs in five or fewer counties, these are listed alphabetically in the text.

Line drawings by Marion Seiler and Peggy Kessler Duke greatly enhance the volume. These are necessarily small, but nevertheless of good quality. They are intermixed with the maps and are to be found on almost every other page throughout the book. A small asterisk after the specific name in the text indicates that there is a drawing. I could, however, find no mention of this practice in the introduction, and it took some time to divine just what the asterisk meant. There are unfortunately no page references for the drawings or for the maps.

Work on the flora began in 1956 with three years of systematic county by county surveying of the vascular flora. Specialized collecting of particular areas and genera followed and in all, the authors accumulated over 200,000 specimens which served as a basis for their writing—a remarkable feat. Responsibility for the treatments of various families was divided among the three authors; a list by family is recorded in the introduction. Other specialist contributors were: W. T. Batson (*Juncus*), Janice Coffey (*Luzula*), D. S. Correll (Orchidaceae), F. C. Hommersand (Boraginaceae), H. R. Totten (Pinaceae, Taxodiaceae, Cupressaceae and Fagaceae), M. Evans (Ferns and Fern Allies) and R. L. Wilbur (Fabaceae).

The authors are to be congratulated for their foresight and perseverance in bringing such a work as this to fruition.

The volume is well bound with a flexible spine which allows the $1\frac{3}{4}$ inch thick book to remain open at any page. There is unfortunately considerable difference in the blackness of the print from page to page in the copy reviewed.

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Two Pioneer Naturalists:
John Goldie, Diary of a Journey through Upper Canada, 1819.

Foreword by WILLIAM SPAWN. Privately printed. x + 65 pp. 1967. $1.75 from University of Toronto Bookstore.

John Kerr McMorine, 1842-1912. Clergyman and Botanist
By EDNA G. ROSS. Privately printed, 21 pp. 1969. $1.00 from the author, Pakenham, Ontario.

John Goldie (1793-1886) was trained as a gardener at the Glasgow Botanic Garden under the direction of W. J. Hooker, Britain's great empire botanist. As a consequence, young Goldie was inspired to make his trip of exploration to America in 1817-19, and trips to Russia in 1824 and 1830. Eventually, in 1844, he emigrated to Canada and settled at Ayr where he farmed, built a mill, and established a pioneer Ontario family.

The diary of his 1819 trip was printed before (in 1897) but is generally unknown; this new printing is therefore most welcome, especially since it is different – unabridged, from the original manuscript recently discovered in the Toronto Public Library. It concerns the journey, on foot, from Montreal (June 4) to Brockville, Kingston, York (June 26), Lake Simcoe, Niagara (July 11), around Lake Ontario to Pittsburg (Aug. 2, "Sept." in error), Geneva, Salina (Syracuse) and Sackets Harbour to Kingston (Aug. 25). Earlier portions of Goldie's diary dealing with Nova Scotia, Quebec, the eastern States, etc. were unfortunately destroyed, along with bundles of specimens by varied accidents, as explained by Mr. Spawn in his useful introduction.

The account is factual and exciting. Goldie was a real vagabond-type and chose to trudge the whole way, sometimes 40 miles a day with pack on back, sleeping-out when night overtook him, idling with strangers, avoiding toll bridges, and exposing himself, almost deliberately it seems, to all the trials of the wilderness,–heat, mosquitoes, storms, rattlesnakes, swamp, thorns and hunger, but always resting on a Sunday to read his books. The record of plants seen, wildlife, soil, landscape, customs, weather, prices, etc., of course, is invaluable Canadiana, set down reliably and forthrightly,–perhaps with a tinge of bravado!

We know Goldie best for the Shield Fern, *Aspidium Goldianum*, named for him by Hooker on a plant from Montreal, carried back to Scotland. Further results from the trip are the some dozen new species he himself described, including our spring Squirrel Corn, *Dicentra canadensis* (Goldie) Walp., and the rare Sundew, *Drosera linearis* Goldie, for which we get details of site and circumstances in the diary. To glean his total botanical contribution we need to consult Joseph Ewan's rejoinder in Rhodora 70: 457-461, 1968.

As a prominent churchman, Rev. McMorine held charges in the early settlements of Renfrew and Lanark Counties in the Ottawa Valley and at Port Arthur, later settling in Kingston. On missions or on holidays for health reasons, he also spent periods at Portage-la-Prairie, Cacouna on the lower St. Lawrence, Lake Papineau in the Laurentians, in Tennessee and the Adirondacks. At each locality the native flora attracted his study, and specimens were meticulously prepared for deposit in the herbarium back at Queen's College, Kingston, where he had had his theological training–and where he had shared the excitement of Professor Lawson's botany classes. On election to Fellowship in the Botanical Society in 1861, McMorine presented a paper on The Plants of Ramsay, the township around his home in Almonte. The manuscript has not survived, and no further floristic writings seem to have been attempted. But the specimens remain, and continue to be cited in the technical literature; this is

why we have to know more about the man, his collecting habits and his travels.

Miss Ross has tallied more than 1200 McMorine specimens, representing some 780 different species. In her brief essay she lists only his Ferns and Orchids as a sample. A map of collecting sites is included. We are grateful to her for researching this enterprising and doubly dedicated Canadian.

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L'Alose et le Gaspereau
(The American Shad and the Alewife)

By JEAN-MARIE ROY. Poissons du Québec, Album Numéro 8. Ministère de l'Industrie et du Commerce du Québec, Direction des Pêcheries, Québec. 24 pages. 1969.

After a pause of five years, another album of the series *Poissons du Quebec* has appeared. Number 8, on the shad and alewife, appears in a slightly smaller format, 8½ x 11 inches, and on finer paper than previous numbers. A pair of a delicately-tinted, life-like color plates by P. Voerodina grace the center of the booklet. A 38-page mimeographed English translation is available for those who do not read French.

Authoritative information on diagnostic features and color, habitat, migrations size, races, spawning, food, predators, distribution, the fishery, and economic importance are included for each species. The text, printing, and design all attest that "Québec sait faire."

One hopes that there will be further numbers in this series.

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Trees of North America: A Field Guide to the Major Native and Introduced Species North of Mexico

By C. FRANK BROCKMAN, illustrated by Rebecca Merrilees. The Golden Field Guide Series, Golden Press, New York. 280 pp., illus. 1968. 4½ x 7½ in. paperback $3.95 (U.S.), clothbound $5.95 (U.S.).

The tourist who has only a passing interest in the trees he sees in his travels as well as the travelling naturalist will find this pocket-size book a most welcome and useful companion. It is the second of a series of guide books published by the Golden Press (see review of the first, Birds of North America by Robbins, Bruun and Zim, Can. Field-Nat. 81 (2): 146: 1967).

This book contains short paragraph descriptions of nearly 600 of some 865 species of trees which are native to North America north of Mexico. In addition, over 100 more important foreign trees which are in cultivation and have become naturalized are also treated. Descriptions are accompanied by marginal disrtibution maps (for the native species) and coloured sketches of leaves and flowers or fruit, and occasionally habit drawings and bark patterns on the opposite page. There are no keys. Identification is accomplished by comparison with the drawings, reference to the text and the distribution maps.

In the introduction, there are short illustrated descriptions of the plant families represented in the book. A page is devoted to the definition of a tree and tree shapes. Two pages of illustrations depict the different types of leaves and leaf shapes, margins, tips, bases and venation. Mention is made of flowers, fruits, bark and twigs. Six forest regions are described briefly and there is a one-page coloured map broadly outlining the vegetation regions of North America.

The colour illustrations are excellent. The maps, largely because of their size,

do present some inaccuracies, e.g. the range of Pitch Pine (*Pinus rigida*) does extend into Canada across the St. Lawrence River at the Thousand Islands and into the southern part of the Eastern Townships of Quebec; Bebb Willow (*Salix Bebbiana*) does occur as a shrub as far north as the southern part of the Mackenzie River Delta in Mackenzie District; and Jack Pine (*Pinus Banksiana*) does not extend as far north as indicated, at least in Mackenzie District. The text is set in a good legible type face, and appears to be quite accurate. The plastic-coated cover of the paperback edition is a welcome feature of a book which is designed for use in the field.

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Insect Pests

By GEORGE S. FICHTER. A Goldon Nature Guide, Golden Press, New York. 160 pp., illus., 1966. 4 x 4 in. paperback $1.00 or clothbound $3.95 (U.S.).

"Insect Pests" is a useful manual for identification and control of common insect and related pests of North America. The cover states that it is 'a guide to more than 350 pests of home, garden, field and forest.' The pests are grouped on the basis of where the damage is observed and Nicholas Strekalovsky has adequately illustrated them in color in all developmental stages with the actual size in fractions of an inch always shown.

Common names are used, omitting reference to either family or scientific names. This is perhaps permissible in a popular guide but leaves something to be desired in accuracy of identification or treatment. The larva figured for the little house fly is certainly not the correct one for *Fannia canicularis* (L.).Too many of the recommendations are general: "Consult your local agricultural agent for treatment."

There is an attempt to cover widely regional pests, from the cotton boll weevil to the spruce budworm, and from the screw worm fly to the Rocky Mountain spotted fever tick. This, however, extends its usefulness to almost every part of the North American continent, to farmers, housewives, gardeners and the average person who requires immediate information on insect pests.

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The Eternal Quest

By ALEXANDER B ADAMS. G. P. Putman's Sons, New York. Longmans Canada Limited, Don Mills, Ontario. 1969. 509 pages. 34 illustrations. $13.75.

This well written book will certainly appeal to the layman, to the intellectual, and to the professional. Alexander Adams has successfully presented biographical accounts of great naturalists from Thales (ca. 640 B.C.-ca. 546 B.C.) "the successful merchant, who helped start men on the search for general scientific laws" to Morgan (1866-1945) who "was one of the early geneticists to experiment with the breeding of fruit flies and to use them for the study of genes".

Most of the chapters contain detailed biographies of outstanding scientists such as Linnaeus, Buffon, Lamarck, Cuvier, Wilson and Audubon, Humboldt, Lyell, Agassiz, Darwin, Wallace, Huxley, and Mendel. Here they appear in their daily life as men, not as pillars

of our contemporaneous scientific knowledge and theories. Alexander Adams, in this respect, has been very successful, for "the first problem was to define a naturalist", and "even among those persons who were indubitably naturalists, the choice was often difficult to make".

Alexander Adams' clearly stated goal was "to write the story of man's discovery of his place in the natural world and to show the qualities and characters of some of the men who did the discovering", in sum, *discoveries* coupled with *biographies* of the men that made the discoveries. I expected to find in this book details related to the great scientific contributions themselves more or less in equal proportion with the so well presented biographies, but the former were briefer than I would have liked. The carefully selected bibliography together with the appendices, however, do compensate somewhat by adding some details on the discoveries.

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OTHER NEW TITLES

Farming the Sea. A. McKee. Crowell, New York, 1969. Illus. 198 p. $6.95 (US).

The World of the Red Fox. Leonard Lee Rue III. Lippincott, Philadelphia, 1969. Illus. 208 p. $5.95 (US).

Animals on Stamps. H. Strom and L. H. Lewy. Philart Productions Ltd., London, 1968. Plates. 398 p. £1 10s.

The Future of the Future. John McHale. Braziller, 1969. Illus. 322 p. Considers the balance of the whole global ecology, the consequences of the explosive growth of the human species, its increased activities and the by-products of civilization. $7.95 (US).

Biological Effects of Pesticides in Mammalian Systems. Herman F. Kraybill (Ed.), N.Y. Academy of Sciences, Annals, Vol. 160, 1969. Illus. 422 p. $23 (US).

Chemical Fallout: Current Research on Persistent Pesticides. Morton W. Miller and George G. Berg (Eds.), 1969. Illus. 531 p. Follows pesticides from their entry into the ecological system, their effect on natural populations, their mechanisms of action in organisms, their effect on human populations and ends with an evaluation of control methods. Obtainable from Charles C. Thomas, 301 East Lawrence Ave., Springfield, Illinois. $22.50 (US).

How to Know the Lichens. Mason E. Hale. Brown, 1969. 428 illustrations. 226 p. $3 (US).

In Defence of Nature. John Hay. Little, Brown, 1969. 210 p. A naturalist's wanderings along the Atlantic coast between Newfoundland and Long Island. $5.00 (US).

The Lure of the Pond. Wallace Kirkland. Regnery, 1969. Illus. 151 p. About insects, plants, birds and other things populating a quiet Wisconsin pond. $6.95 (US).

Saskatoon Wetlands Seminar. Canadian Wildlife Service Report Series No. 6. Queen's Printer, Ottawa, 1969. Illus. 262 p. Transactions of a seminar on small water areas in the prairie pothole region, held February 20 to 22, 1967, to mark the opening of the Prairie Migratory Bird Research Centre in Saskatoon, Saskatchewan. $5.25.

World Crop Protection. Volume 1, Pests and Diseases. J. H. Stapley and F. C. H. Gayner, CRC Press, International Scientific Series, 1969. Illus. 270 p. $18.85 (US).

The Biology of Marine Mammals. H. T. Anderson (Ed.), Academic Press., New York, 1969. Illus. 511 p. $21.50 (US).

Arctic Bibliography. Volume 14. Marie Tremaine (Ed.), McGill University Press, 1969. 1,792 p. Provides a key to scientific publications available in the principal libraries of the world, relating to the Arctic and Subarctic, and other low-temperature conditions. This volume includes over 8,500 abstracts of recent scientific publications. Subjects covered include geology, meteorology, oceanography and the humanities.

Administration, native populations, economic conditions and public health and welfare receive special attention. $20.00.

The Year of the Whale. Victor Scheffer. Scribner, 1969. Illus. 213 p. $6.95 (US).

Pleistocene Mammals of Europe. Bjorn Kurten. Aldine, Chicago, 1968. Illus. 320 p. $11.75 (US).

Effects of Pesticides on Fruit and Vegetable Physiology. Subcommittee on Chemicals Affecting Fruit and Vegetable Physiology, Committee on Plant and Animal Pests, National Research Council, National Academy of Sciences, Washington, D.C. 1968. 90 p. $3.25 (US).

The Nations Water Resources Summary Report. An assessment of the Water Resources Council, Washington, D.C. 1968. Superintendent of Documents, Washington, D.C. Illus. 32 p. $0.65 (US).

Anatomy of the Monocotyledons, Volume III, Commelinales-Zingiberales. P. B. Tomlinson, Oxford at the Clarendon Press, 1969. Illus. 446 p. $14.75 (US).

Ethology of Mammals. R. F. Ewer. Plenum Press, N.Y., London Logos Press, 1968. Illus. 418 p. $26. (US).

Moths and How to Rear Them. Paul Villiar. Funk and Wagnalls, 1969. Illust. by the author. 242 p. A modern rearing manual for the amateur and professional breeder. The result of nine years of study includes appendices depicting winter twigs and guide to food plants. $10. (US).

The Quality of the Urban Environment. Essays on "New Resources" in an Urban Age. Harvey S. Perloff (Ed.), Resources for the Future, Johns Hopkins Press, 1969. Illus. 332 p. Paperback, $6.50 (US).

Urban Dynamics. Jay W. Forrester. M.I.T. Press, 1969. Illus. 285 p. A computer-aided analysis of urban growth and decay, examines the city as a self-regulating system that has its own evolution. $12.50 (US).

Introduction to the Mathematics of Population. Nathan Keyfitz. Addison-Wesley, Reading, Mass., 1968. Illus. 450 p. $13.50 (US).

Providing Quality Environment in Our Communities. A public lecture series, Washington, D.C., 1967. Ward W. Konkle (Ed.), Graduate School Press, U.S. Department of Agriculture, Washington, D.C., 1968. Illus. 152 p. Cloth $5.25; Paperback, $3 (US).

Wildlife in Danger. James Fisher, Noel Simon, Jack Vincent and members and correspondents of the Survival Service Commission of the International Union for Conservation of Nature and National Resources, (IUCN) Viking, New York, 1969. Illus. 368 p. $12.95. A Studio Book.

Environment and Cultural Behavior. Ecological Studies in Cultural Anthropology. Andrew P. Vayda (Ed.), Published for the American Museum of Natural History by Natural History Press, Garden City, N.Y., 1969. Illus. 486 p. Cloth $7.95; Paperback $2.95 (US). American Museum Sourcebooks in Anthropology.

Oceanographic Atlas of the Pacific Ocean. Richard A. Barkley, University of Hawaii Press, Honolulu, 1968. Illus. 180 p. $30 (US).

Pollution: What It Is . . . What It Does . . . What Can Be Done About It. W. J. Maunder and H. D. Foster (Eds.), Evening Division University of Victoria, Victoria, B.C., Canada, 1969. 118 p. Paperback $1.50

Prehistory of North America. Jesse D. Jennings. McGraw-Hill, New York, 1969. Illus. 402 p. $9.95 (US).

Environment and Resources. From Conservation to Ecomanagement, Jaro Mayda. School of Law, University of Puerto Rico, Rio Piedras, 1968. 254 p. Paperback $3 (US).

Darwin's South America. Robert S. Hopkins. Day, 1969. Illus. 224 p. Geographer's fresh evaluation of the young naturalist's achievements, observations and discoveries, with excerpts from Darwin's writings reviewed in their historical perspective. $5.95 (US).

Family Planning Perspectives. A new quarterly magazine sponsored by a division of Planned Parenthood – World Population, 545 Madison Avenue, New York 10022, is available upon request from the Technical Assistance Division. For persons who often think of family planning and population control. Deals with legal problems and public policy in regard to birth control programs and similar matters.

The Academy of Sciences of the USSR, a Brief Account of its History and Work. Obtainable from the Joint Publication Research Service, JPRS 47808, Commerce Department, Washington, D.C. $3 (US).

Lewis and Clark: Pioneering Naturalists. P. R. Cutright. University of Illinois Press, Urbana, 1969. Illus. 510 p. $12.50 (US).

Eskimo Prehistory. Hans-Georg Bandi. Translated from the German edition by Ann E. Keep. University of Alaska Press, College, Alaska, 1969. (Distributed by University of Washington Press, Seattle, Wash.) Illus. 228 p. $6.50 (US). Studies of Northern Peoples, No. 2.

Insect Vision. G. A. Mazokhin-Porshnyakov. Translated from the Russian by R. and L. Masironi. T. H. Goldsmith (Translation Ed.). Plenum Press, New York, 1969. As compared with the Russian edition this United States' one contains some changes and additional information, based on more recent information from the literature. Illus. 306 p. $23.50.

The World of Dragonflies and Damselflies. Ross E. Hutchins. Dodd, Mead, New York, 1969. Illus. 128 p. $4.25 (US).

International Conference on Oil Pollution of the Sea. Report of proceedings, Rome, 1968. Obtainable from the Secretary, British Advisory Committee on Oil Pollution of the Sea, Natural History Museum, London. Illus. 416 p. Paperback. 40s.

Concepts of Ecology. E. J. Kormondy. Prentice-Hall, Englewood Cliffs, N.J., 1969. Illus. 210 p. Paperback $2.95 (US).

Molecular Approaches to Ecology. M. Florkin and E. Schoffeniels. Academic Press, N.Y., 1969. Illus. 204 p. $10 (US).

Seaweeds of Cape Cod and the Islands. J. M. Kingsbury. Illustrated by E. and M. Norman. Chatham Press, Chatham, Mass. 1969. 214 p. $12.50 (US).

Water, Earth and Man: A Synthesis of Hydrology, Geomorphology, and Socio-Economic Geography. R. J. Chorley (Ed.), Methuen, London, 1969. Illus. 588 p. $16 (US).

Migration and Dispersal of Insects by Flight. C. G. Johnson. Methuen, London, 1969. Illus. 766 p. $24 (US).

The Ecology of Reproduction in Wild and Domestic Animals. R. M. R. S. Sadlier. Methuen, London, 1969. Illus. 324 p. $12 (US).

Speciation in Tropical Environments. Papers from a symposium, London, October-November, 1968. R. H. Lowe-McConnell (Ed.). Linnaean Society of London. Published by Academic Press, New York, 1969. Illus. 248 p. $11.50 (US). Includes 15 papers.

Conservation in a Changing World. Proceedings of a conference held in Toronto, March 13-14, 1969. The Conservation Council of Ontario, Suite 604 - 11 Adelaide Street West, Toronto. 113 p.

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Compiled by Charlotte E. Dill

Note: Where a species is named in the text by both scientific and common names, it has been indexed by scientific name only. Species are indexed by common names if the name appears in the title of an article or if the scientific name has not been used in the article.

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ERRATUM

THE paper entitled "Regional Population Declines and Organochlorine Insecticides in Canadian Prairie Falcons" (Canadian Field-Naturalist 83:191-200) contains an error on page 194. The error, which reverses areas D and F is in paragraph 3, lines 6 and 8. This sentence should read: The number of known occupied Peregrine Falcon territories in area F had also declined from six in 1960 (Dekker, 1967) to none in 1968, and the two in area D also became unoccupied during the same interval. (See also the letter by Mr. Decker on page 410 of this issue).

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